

FIELD MANUAL

**105-MM HOWITZER
LIGHT, M102, TOWED**

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MARCH 1970



CHANGE }

No. 1 }

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DEPARTMENT OF THE ARMY
WASHINGTON, DC, 31 October 1972

105-MM HOWITZER, LIGHT, M102, TOWED

FM 6-70, 27 March 1970, is changed as follows:

✓ Page 32, Chapter 9. Change title to read "BORESIGHTING".

✓ Page 37, Chapter 10. Change title to read "BASIC PERIODIC TESTS".

✓ Page 37, paragraph 104b. Change paragraph to read "Level to trunnions by using a plumbline (para 90).".

✓ Page 37, paragraph 104d. Change to read "104-c".

✓ Page 38, paragraph 109. In line 9, delete entire sentence beginning with "The test of . . . either level or canted.".

✓ Page 38, paragraph 109. In line 12, change sentence to read "The test described in paragraph 110 reflects the total errors in the entire mechanism.".

✓ Page 38, paragraph 110a. In line 1, "the tube at a low elevation," is changed to read "the tube at zero elevation,".

✓ Page 38, paragraph 110b. Change paragraph to read "Elevate the tube from minimum to maxi-

mum elevation in 300-mil steps. If the tube moves off the plumbline, raise one side of the weapon until line of sight through the tube is on the plumbline. When the tube will track the plumbline throughout the elevation limits, the trunnions are considered level. Depress the tube to zero elevation. Level the telescope mount by centering the pitch and crosslevel bubbles.".

✓ Page 38, paragraph 110c. Change paragraph to read "Place the intersection of the crosshairs of the panoramic telescope reticle on any sharply defined aiming point and note deflection.".

✓ Page 39, paragraph 110d. Change paragraph to read "Elevate the tube from minimum to maximum elevation in 100-mil steps. If the vertical crosshair of the panoramic telescope deviates from the aiming point by more than 1 mil between elevation zero and 900 mils or 3 mils above 900 mils or if either level vial on the telescope mount moves in excess of one-half vial graduation, the telescope mount is out of adjustment or improperly mounted. Refer the weapon to direct support maintenance personnel for adjustment.".

By Order of the Secretary of the Army:

Official:

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General, United States Army
Chief of Staff

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Major General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-11 requirements for 105 MM Howitzer, LT, M 102, Towed.

* This change supersedes DA Message R 121754Z Sep 72, Subject: Change to FM 6-70.

FIELD MANUAL

No. 6-70

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., 27 March 1970

105-MM HOWITZER, LIGHT, M102, TOWED

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*This manual supersedes FM 6-70, 7 April 1964.



Chapter 1

GENERAL

1. Purpose and Scope

a. This manual is a guide to assist commanders and chiefs of sections in developing M102 howitzer sections into efficient, smooth working teams with a sense of discipline. This manual prescribes individual duties and section drill, maintenance and inspection procedures, tests and adjustments for sighting and fire control equipment, and instructions for the destruction and decontamination of equipment.

b. The material contained herein is applicable to both nuclear and nonnuclear warfare without modification.

c. Users of this manual are encouraged to submit recommended changes and comments to improve the publication. Comments should be keyed to the specific page, paragraph and line of the text in which the change is recommended. Reasons will

be provided for each comment to insure understanding and complete evaluation. Comments should be prepared using DA Form 2028 (Recommended Changes to Publications) and forwarded direct to the Commandant, US Army Field Artillery School, ATTN: AKPSIAS-PL-FM, Fort Sill, Oklahoma 73503.

2. Description of Equipment

The M102 (fig 1) is a light, towed, 105-mm howitzer used primarily in airborne division, separate airborne brigade, separate light infantry brigade, and airmobile division as authorized by appropriate Tables of Organization and Equipment. A circular firing base provides a 6,400-mil capability as the carriage pivots by means of a roller tire located at the rear of the trail assembly. Data on the howitzer and basic issue items are presented in TM 9-1015-234-12. Section equipment is shown in figure 2.

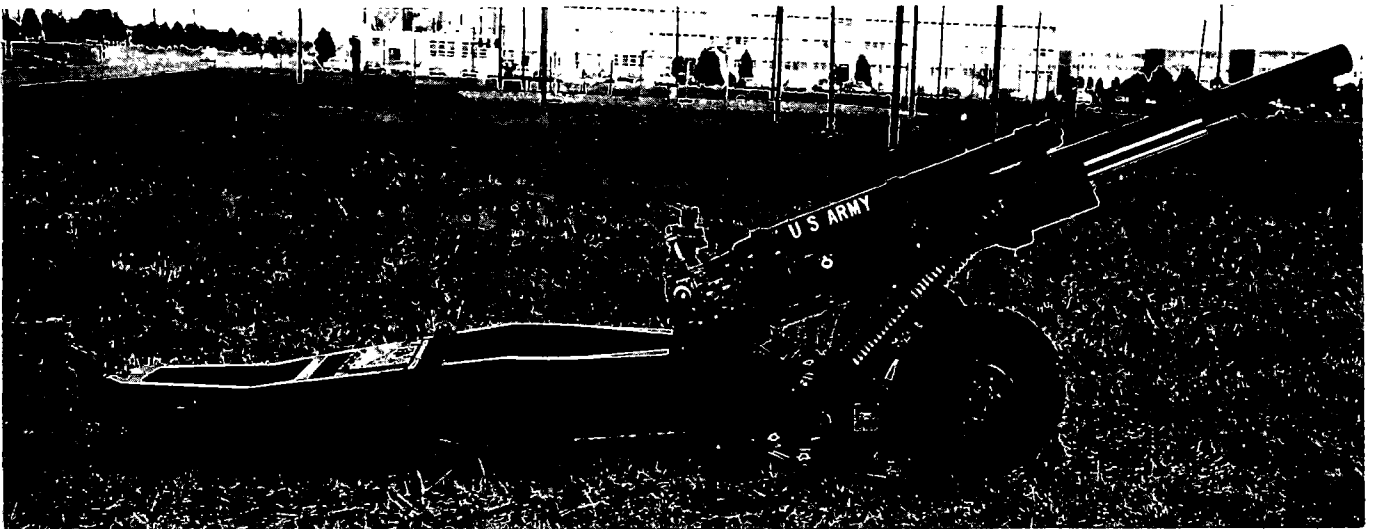


Figure 1. Light, towed, 105-mm howitzer M102.

3. Definition of Terms

a. Section. Tables of Organization and Equipment (TOE's) prescribe the personnel and equipment comprising each section of a battery. In this manual the term section is often used to designate only the personnel required to serve the weapon and equipment.

b. Front.

(1) When the howitzer is coupled, the front is the direction in which the prime mover is pointed.

(2) When the howitzer is uncoupled, the front is the direction in which the muzzle points.

c. Right (Left).

(1) To determine the left or right of the howitzer itself, coupled or uncoupled, the front is the direction in which the muzzle points.

(2) The direction right (left) is the right (left) of one facing to the front.

4. References

Publications pertaining to the M102 howitzer and auxiliary equipment on matters which are not discussed in detail in this manual are listed in appendix A.

Chapter 2

ORGANIZATION

5. Composition of the Howitzer Section

The howitzer section consists of section personnel; a light, towed, 105-mm howitzer M102; auxiliary equipment; and a prime mover, when applicable.

a. The personnel of the howitzer section in the airborne division and separate light infantry brigade are the—

- (1) Chief of section (CS).
- (2) Gunner (G).
- (3) Assistant gunner (AG).
- (4) Five cannoneers, numbers 1 through 5.
- (5) Prime mover driver (D).

b. The personnel of the howitzer section in the airmobile division are the—

- (1) Chief of section (CS).
- (2) Gunner (G).
- (3) Assistant gunner (AG).
- (4) Four cannoneers, numbers 1 through 4.

Note. The duties as listed in the tables of this manual are those of personnel of a standard 105-mm howitzer section of the airborne division or separate light infantry brigade. In the howitzer section of the airmobile division, the duties of the number 5 cannoneer are assigned to the number 3 and 4 cannoneers as appropriate.

c. Section equipment (fig 2) is listed in appropriate TOE's.

6. General Duties of Personnel

a. *Chief of Section.* The chief of section is the noncommissioned officer in command of the section and as such, is responsible to the battery executive officer for—

- (1) Training and efficiency of personnel.
- (2) Performance of duties in section drill, in firing, in tests and adjustment of sighting and fire

control equipment, and in inspection and maintenance of all section equipment, including scheduled preventive maintenance service of the howitzer and section vehicle.

(3) Observance of safety precautions.

(4) Preparation of field fortifications for protection of equipment, ammunition, and personnel.

(5) Camouflage discipline, local security, and chemical, biological, and radiological (CBR) warfare security discipline.

(6) Maintenance of the Equipment Log Book.

(7) Police and improvement of the section area.

b. *Gunner.* The gunner is the principal assistant to the chief of section in performing the duties specified in a above. The gunner's specific duties are prescribed in chapters 5 and 6 and tables 1 through 4. All tables are located in the back of this manual.

c. *Assistant Gunner.* The assistant gunner assists the gunner in performing his duties and, in an emergency, acts as the gunner. The assistant gunner's specific duties are prescribed in chapters 5 and 6 and tables 1 through 4 of this manual.

d. *Cannoneers.* Cannoneers perform the specific duties listed in the manual and any other duties assigned by the chief of section.

e. *Driver.* The driver's primary duty is to drive the section vehicle and perform preventive maintenance on the vehicle. The driver performs other duties prescribed by this manual and by the technical manuals pertaining to his vehicle and duties assigned by the chief of section. He should be trained to perform the duties of all members of the section in firing.

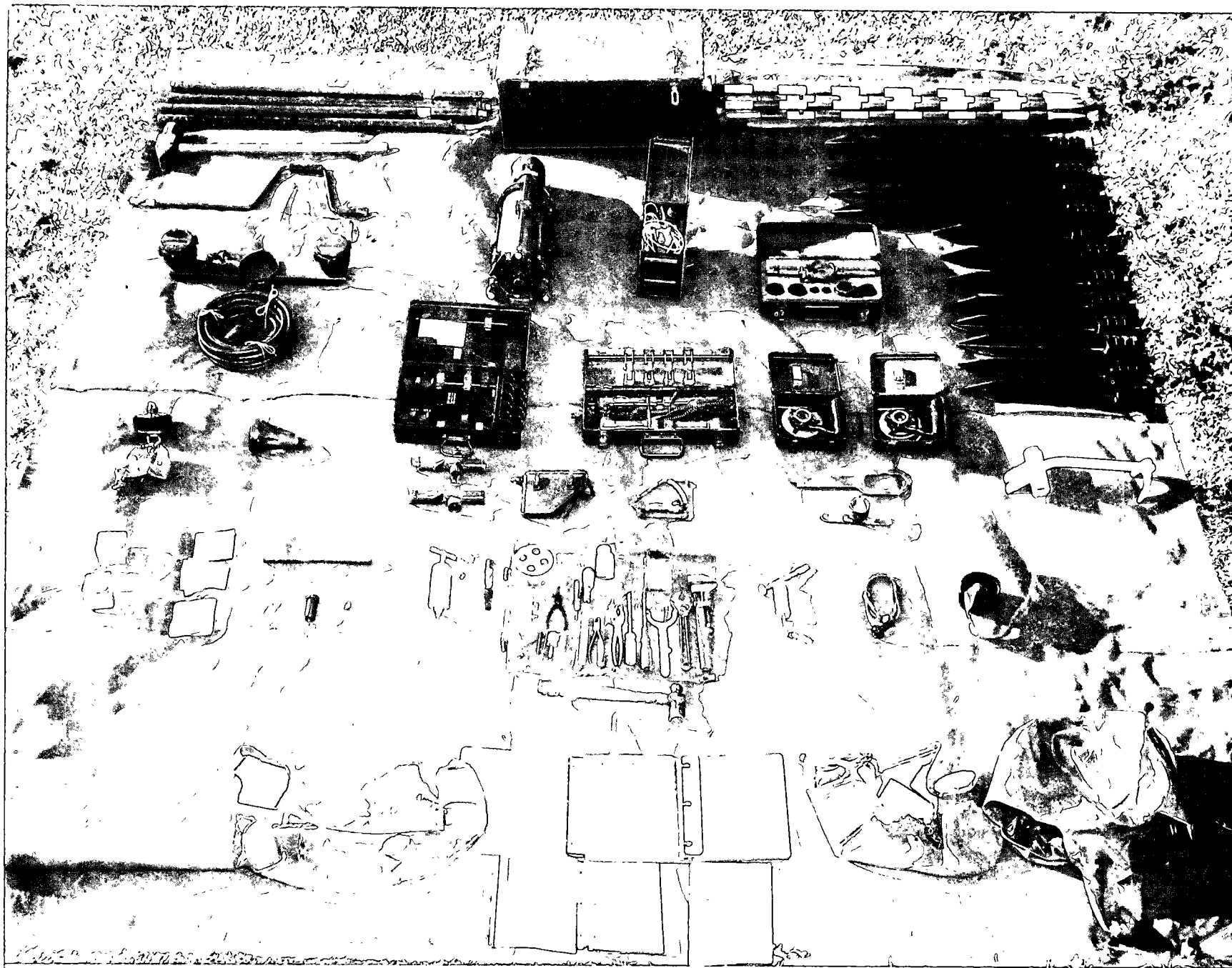


Figure 2. Section equipment.

Chapter 3

SECTION DRILL

Section I. GENERAL

7. Purpose

The purpose of section drill is to develop maximum efficiency and precision coupled with high speed. Commands and formations for section drill are prescribed in this chapter.

8. Instructions

a. Adherence to drills prescribed in this manual is necessary to develop maximum efficiency and to prevent injury to personnel and damage to equipment. Section drill must be conducted in silence, except for commands and reports. The section must be drilled until reactions to commands are automatic, rapid, and efficient.

b. Errors must be corrected immediately. Each member of the section must be impressed with the

importance of reporting promptly to the chief of section any errors discovered before or after the command to fire has been given. The chief of section will immediately report errors to the executive officer.

c. Battery officers supervise the drill to insure that instructions are carried out and that maximum efficiency is obtained.

d. Duties should be rotated during training so that each member of the howitzer section can perform all the duties within the section. In addition, all battery personnel not assigned to the howitzer sections should be trained in the fundamentals of section drill in order that they will be capable of functioning efficiently with a howitzer section if required.

Section II. PRELIMINARY COMMANDS AND FORMATIONS

9. To Form the Section

To form the section, the chief of section takes his post and gives one of the following commands explained in *a* through *c* below. At the first formation for a drill or exercise, the caution AS A SECTION precedes the command.

a. To form the section, the command is FALL IN. The section—

(1) Moves at double time.

(2) Forms in single rank at close interval with the gunner on the right, the assistant gunner, and cannoneers in numerical order, and the driver at the left of the rank.

(3) Centers on the chief of section at a distance of 3 paces (fig 3).

b. To form the section in a particular place, the command designates the place; for example, IN FRONT (REAR) OF YOUR PIECE, FALL IN. The section—

(1) Moves and forms a single rank as described in *a* above.

(2) Faces the direction of fire.

c. To form the section in a particular direction, the command designates the direction; for example, ON THE ROAD FACING THE PARK, FALL IN. The section—

(1) Moves and forms a single rank as describe in *a* above.

(2) Faces the direction indicated in the command.

10. To Call Off

With the section in formation, the command is CALL OFF.

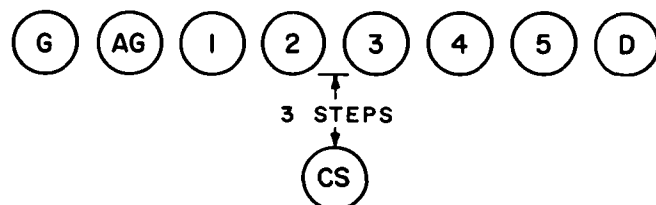


Figure 3. Section in formation.

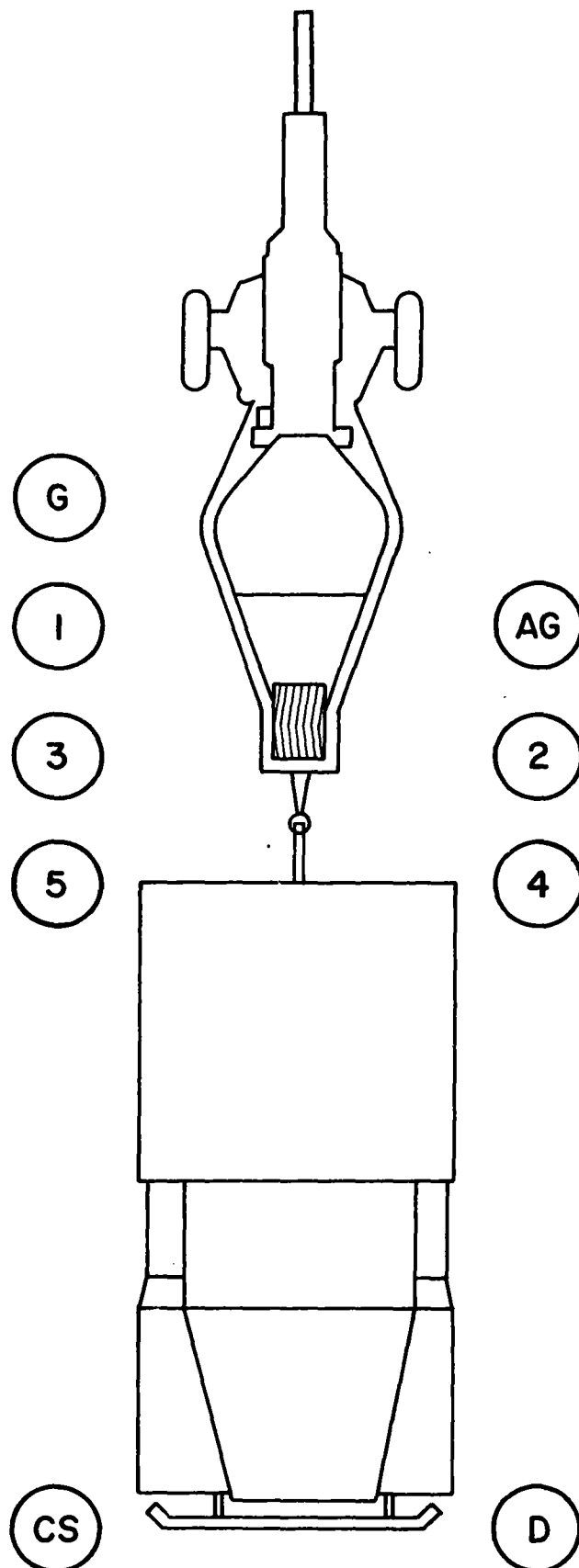


Figure 4. Posts of section, piece uncoupled.

a. All personnel except the gunner execute eyes right.

b. The section calls off in sequence: "Gunner," "Assistant gunner," "1," "2," "3," "4," "5," "Driver."

c. As each man calls out, he turns his head smartly to the front.

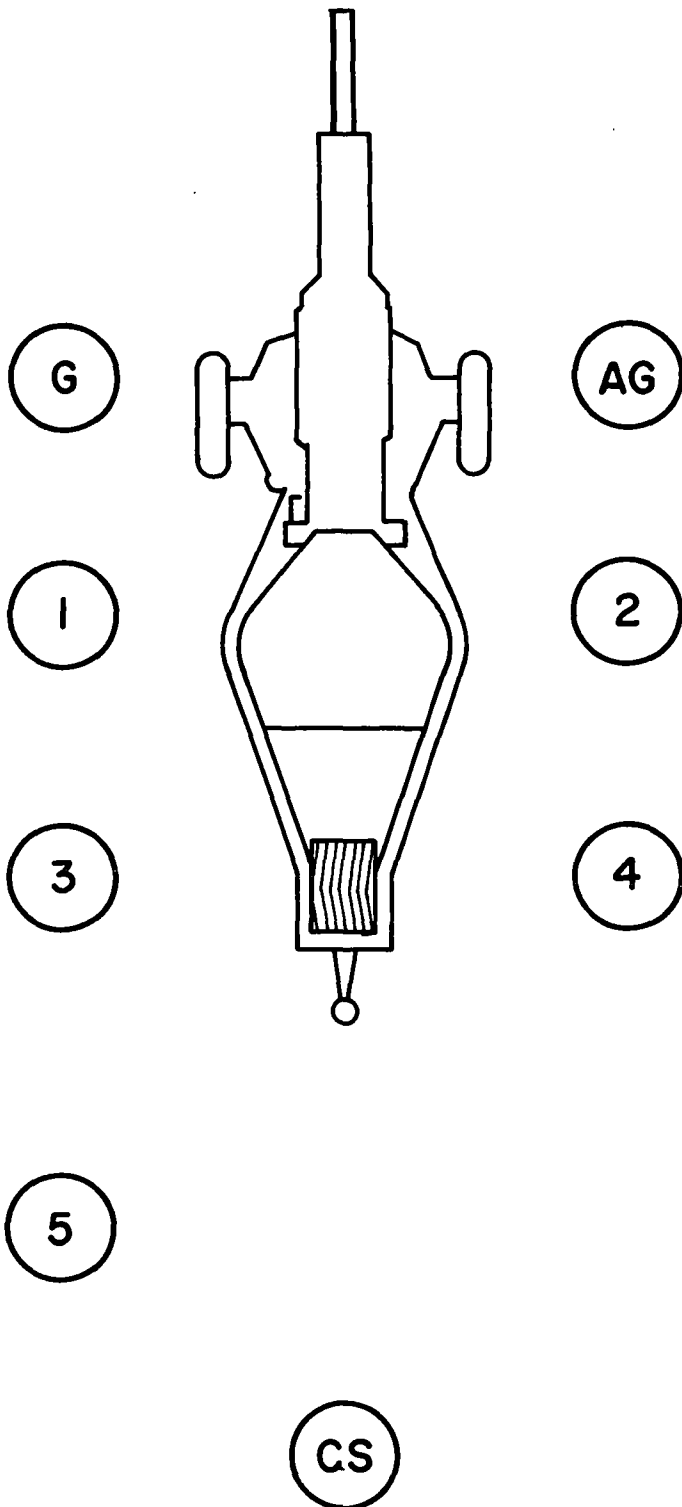


Figure 5. Posts of section, piece uncoupled and march ordered.

11. To Post the Section

The command is CANNONEERS, POSTS.

a. The command is general and may be given when the section is in or out of ranks, at a halt, or marching.

b. All movements are executed at double time and are terminated at the position of attention.

c. The section moves to posts as shown in figures 4, 5, and 6.

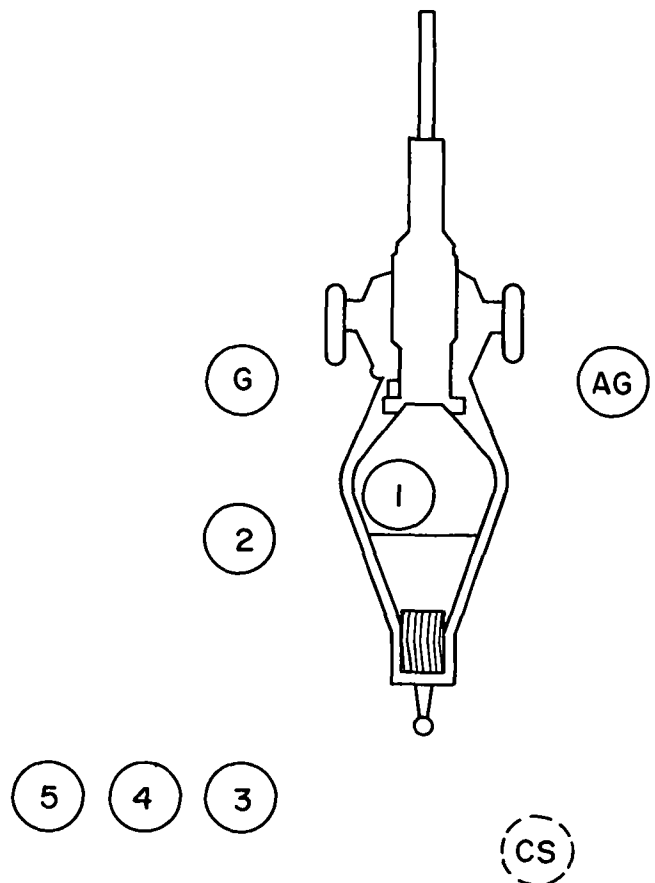


Figure 6. Posts of section, prepared for action.

12. To Change Posts

To train all members of the section in all duties and to lend variety to drill, posts of section personnel should be rotated frequently. With the section in formation (fig 3), the command is CHANGE POSTS, MARCH, or SECTION CHANGE POSTS, MARCH.

a. At the command CHANGE POSTS, MARCH, the assistant gunner and cannoneers 1 through 4 take two left steps so that each takes the position of the next higher number cannoneer. At the same time the number 5 cannoneer moves at double time behind the rank to the post of assistant gunner. All other members of the section stand fast.

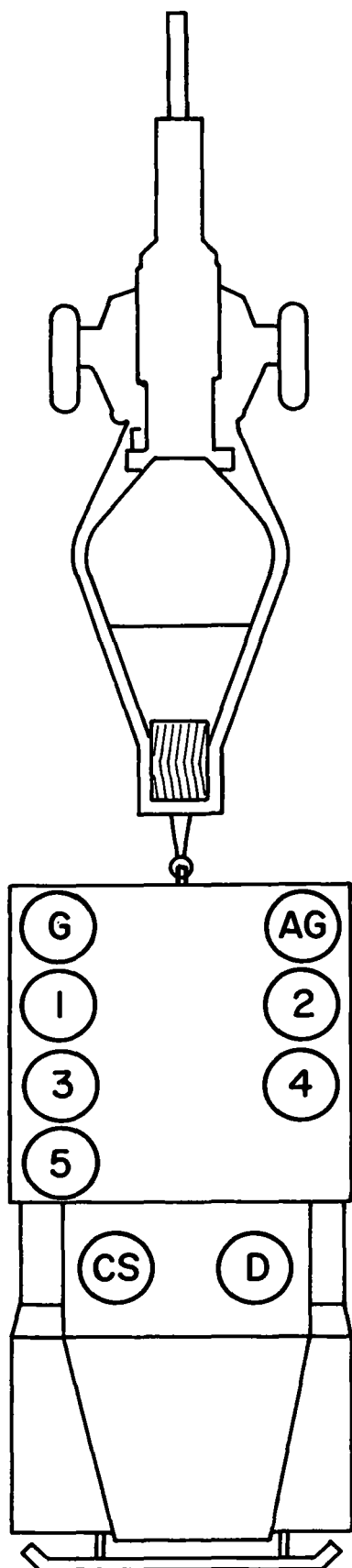


Figure 7. Post of section mounted with piece coupled.

b. At the command **SECTION CHANGE POSTS, MARCH**, all members of the section except the left most man in the rank take two left steps. The left most man moves at double time to the post of gunner.

13. To Mount

To mount, the command is **PREPARE TO MOUNT, MOUNT** or simply **MOUNT**. If any member of the section is not to mount, the command should indicate that he is to stand fast. For example, **PREPARE TO MOUNT, DRIVER STAND FAST, MOUNT**.

a. **PREPARE TO MOUNT, MOUNT** is executed as follows:

(1) At the preparatory command, the section moves at double time to the positions shown in figure 4.

(2) At the command of execution, personnel mount and take positions as shown in figure 7.

(3) Each cannoneer is assisted by the man directly behind (or in front of) him to insure rapid mounting, and to prevent injuries.

(4) Before the chief of section mounts, he will verify that the howitzer is properly coupled, that personnel and equipment are aboard the vehicle and that the tailgate and safety strap are secure.

b. If the command is **MOUNT**, the section mounts in the manner and order prescribed for the command, **PREPARE TO MOUNT, MOUNT** except that dismounted posts are not taken. The section moves directly to the positions shown in figure 7.

14. To Dismount

The command is **PREPARE TO DISMOUNT, DISMOUNT** or simply **DISMOUNT**.

a. At the preparatory command, the personnel mounted in the section vehicle unhook the safety strap and unlatch the tailgate of the vehicle, and all members of the section assume a standing position from which they can dismount promptly. At the command of execution, personnel dismount and doubletime the posts shown in figure 4.

b. If the command is simply **DISMOUNT**, the section dismounts as prescribed for the command **PREPARE TO DISMOUNT, DISMOUNT**, and double time to the positions shown in figure 4.

15. To Fall Out

a. At *Drill*. When it is desired to give the personnel a rest from drill or to relieve them tempo-

rarily from formation or posts, the command FALL OUT is given. The command may be given at any time and means that the section is to remain in the drill area.

b. When Firing. When firing has been suspended temporarily and the section is to remain in

vicinity of the piece, the command FALL OUT is given. Personnel must stand clear of the piece to insure that settings and laying remain undisturbed. During these periods, the chief of section may direct the section personnel to improve the position, to replenish ammunition, or to do other necessary work.

Chapter 4

PREPARATIONS FOR FIRING AND TRAVELING

16. General

a. The weapons of a battery will normally be put into position individually under the direction of the battery executive officer, the chief of firing battery and the chiefs of section. Preparation of the firing position prior to occupation is governed by time and personnel available, and by unit SOP.

b. When position areas are to be occupied, and reconnaissance has not been possible, a thorough map reconnaissance of the area to be occupied will assist the battery executive officer, chief of firing battery, and chiefs of section to plan and execute an orderly occupation of position.

17. Preparations at the Position

The following preparation will facilitate the occupation of a position.

a. Drive a stake at each howitzer position to indicate the place over which the panoramic telescope is to be placed.

b. Place another stake at a distance of 50 to 100 meters in the approximate direction of fire, at which the tube can be pointed, or have the chief of firing battery stand facing the direction of fire with his arms horizontal to the ground to indicate the general direction of fire to each section as the howitzer is pulled into position. Each vehicle is

halted at its proper place by the chief of section using the appropriate arm and hand signals for guiding the vehicle. Hand signals for guiding the vehicle are described in FM 21-60 and TM 21-306.

c. Insure that the howitzer position is free of any obstructions that will prevent traverse of the weapon.

18. Preparations for Firing

a. To prepare for firing, the command is **PREPARE FOR ACTION** and can be given when the howitzer is in position or approaching the position. Duties of individuals are performed at double time in the sequence as indicated in table 1. Each man takes his post (fig 6) on completion of his duties.

Note. Tables 1 through 8 are located in the back of the manual.

b. If the howitzer is not to be prepared for action at the firing position, the command **DO NOT PREPARE FOR ACTION** must be given.

19. Preparations for Traveling

To prepare the howitzer section for traveling, the command is **MARCH ORDER**. Duties of individuals are given in table 2. Each man takes his post (fig 4) after completing his duties and mounts the vehicle on command from the chief of section.

Chapter 5

DUTIES IN FIRING, INDIRECT LAYING

Section I. GENERAL

20. Firing by Indirect Laying

Indirect laying is the method most frequently used for laying a weapon on a target. Indirect laying is a method of aiming a weapon by placing the line of sight of the panoramic telescope on an aiming point other than the target itself. To provide timely and accurate fire, the section must be imbued with a sense of urgency. Personnel must make every possible effort to deliver the timely and effective fires.

21. Instructions

The general instructions in paragraphs 7 and 8 on the conduct of section drill apply equally to section drill in duties in firing by indirect laying. The sequence of duties performed in firing is shown in table 3. For duties of the battery executive officer, see FM 6-40 and FM 6-140.

22. Duties of Individuals

The general duties of section personnel in indirect fire are given in *a* through *h* below.

a. The chief of section supervises and commands his section and is responsible for insuring that all

personnel of the section perform their duties properly, execute all commands, and observe all safety precautions.

b. The gunner sets the announced deflection and is responsible for taking up the correct sight picture on the panoramic telescope.

c. The assistant gunner sets the announced quadrant, opens and closes the breech, and fires the weapon on command from the chief of section.

d. The number 1 cannoneer is responsible for loading the howitzer and for discarding empty cartridge cases to the rear of the howitzer after each round is fired.

e. The number 2 cannoneer fuzes the projectile.

f. The number 3 cannoneer prepares the propellant charge.

g. The number 4 and number 5 cannoneers remove the ammunition from the containers.

h. The driver, after his vehicle is unloaded, drives to the truck park and performs preventive maintenance on his vehicle unless the chief of section directs otherwise.

Section II. DUTIES OF CHIEF OF SECTION

23. List of Duties

The chief of section—

a. Indicates the aiming point to the gunner.

b. Measures the angle of site to crest.

c. Follows fire commands.

d. Verifies fuze setting, propelling charge, deflection and elevation.

e. Indicates when the piece is ready to fire.

f. Gives the command to fire.

g. Reports errors and other unusual incidents of fire to the battery executive officer.

h. Records basic data.

i. Lays the piece for elevation, assisted by the assistant gunner, when the gunner's quadrant is used.

j. Measures the quadrant.

k. Conducts prearranged fires.

l. Observes the functioning of the materiel and checks the recoil oil reserve frequently.

m. Assigns duties when the section is operating at reduced strength.

n. Verifies the adjustment of the sighting and fire control equipment.

o. Checks all ammunition prepared but not fired before it is stowed for travel.

24. Indicates the Aiming Point to the Gunner

When a distant aiming point has been designated by the executive officer or chief of firing battery, the chief of section will insure that he has properly identified the point designated. He will then indicate this point to the gunner. If there is any possibility of misunderstanding, the chief of section will turn the panoramic telescope until the horizontal and vertical crosshairs are centered on the designated aiming point.

25. Measures the Angle of Site to Crest

a. At the command MEASURE SITE TO CREST, the chief of section sights along the lowest element of the bore and directs the gunner and assistant gunner to traverse and elevate the tube until the line of sight just clears the crest of each sector of fire at its highest point. The assistant gunner centers the cross-level and pitch-level bubbles, and the chief of section determines the elevation from the elevation counter and reports to the executive officer, NUMBER (so-and-so), SITE TO CREST (so much).

b. When the executive officer announces the minimum quadrant elevation for each charge, the chief of section records the data in a notebook.

26. Follows Fire Commands

The chief of section will follow the fire commands and he will repeat the commands to the section as required.

27. Indicates When the Piece Is Ready To be Fired

When the executive officer can see arm signals made by the chief of section, the chief of section will raise his right arm vertically as a signal that the piece is ready to be fired. He gives the signal as soon as the gunner calls READY and all cannoneers are in their proper places. When arm signals cannot be seen, the chief of section reports orally to the executive officer NUMBER (so-and-so) READY.

28. Gives the Command to Fire

The chief of section will give the assistant gunner the command to fire by dropping his right arm sharply to his side and, at the same time, command FIRE.

29. Reports Errors and Unusual Incidents of Fire to the Executive Officer

If the piece does not fire or cannot be fired, the chief of section will promptly report that fact and the reasons therefor to the executive officer; for example, NUMBER (so-and-so) MISFIRE. If an error in laying is discovered after the piece has been fired, the chief of section will report that fact at once; for example, NUMBER (so-and-so) FIRED 40 MILS RIGHT. If the gunner reports that the aiming posts are out of alinement, the chief of section will report that fact and, during the next lull in firing will ask permission to realine them. On occasion, the same type of report may be required if the gunner has difficulty in obtaining the proper sight picture when using the collimator. The chief of section promptly reports all other unusual incidents that affect the service of the piece.

30. Records Basic Data

The chief of section will record data of a temporary nature in a notebook and will have the gunner record the data on the section data board when appropriate. Data to be recorded include minimum elevation; aiming points used and their deflections; prearranged fires; safety limits in elevation and deflection; date, hour, and number of rounds fired; and calibration and special corrections when appropriate.

31. Lays the Piece for Elevation When Gunner's Quadrant Is Used

a. Although the elevation counter is normally used in laying for elevation, the gunner's quadrant may be used to lay for elevation when a refinement greater than 1 mil is desired. The command is USE GUNNER'S QUADRANT.

b. The announced quadrant is set on the gunner's quadrant by setting 10-mil increments on the frame arc and 1-mil and 0.1-mil increments with the micrometer knob. For example, quadrant 348.2 is set on the gunner's quadrant as follows: The upper edge of the plunger plate is set opposite the 340 mark on the scale on the arc and the micrometer on the leveling arm is set to 8.2. Care must be taken to insure that the same side of the quadrant is used in setting both the plunger plate and the micrometer.

c. After the howitzer has been laid for direction and loaded, and the breechblock has been closed, the chief of section stands squarely opposite the quadrant seats and places and holds the gunner's quadrant firmly on the seats. The quadrant must

be placed so that the words "line of fire" appear at the bottom of the quadrant with the arrow pointed toward the muzzle. The chief of section must be sure to use the arrow which appears on the same side of the quadrant as the scale that he is using. For subsequent settings, the chief of section must take the same position, hold the quadrant in the same manner, and view the quadrant bubble from the same angle that he used for the initial setting to insure consistency in leveling.

d. The chief of section then directs the assistant gunner to elevate or depress the tube until the quadrant bubble is centered. The chief of section cautions the assistant gunner when the bubble approaches center so that the final leveling may be performed accurately.

32. Measures the Quadrant

a. When the piece has been laid and the command MEASURE THE QUADRANT is announced, the chief of section directs the assistant gunner to center the cross-level bubble and turn the elevation knob until the bubble in the elevation vial is centered. The chief of section then reads the quadrant in the elevation counter window and reports the quadrant elevation setting as NUMBER (so-and-so), QUADRANT (so much).

b. The quadrant can also be measured by placing the gunner's quadrant on the quadrant seat of the fire control quadrant M14 and centering the bubble by moving the index arm and turning the micrometer knob. The reading recorded is reported as described in a above.

33. Conducts Prearranged Fires

When the execution of prearranged fires is ordered, the chief of section conducts the fire of his section in conformity with the prescribed data.

38. List of Duties

The gunner—

a. Centers the pitch- and cross-level bubbles on the panoramic telescope mount.

b. Lays the piece for direction.

c. Directs alinement and realinement of the infinity aiming reference collimator or aiming posts in case of piece displacement.

d. Sets off a common deflection to a common aiming point after the piece has been laid.

34. Observes and Checks Functioning of Materiel

The chief of section closely observes the functioning of all parts of the materiel during firing. Before firing, he checks to insure that the recoil system has the proper amount of oil, ensures that no leaks exist and directs servicing as required. He promptly reports to the executive officer any evidence of malfunctioning.

35. Assigns Duties When the Section Is Operating With Reduced Strength

When the number of personnel serving the piece is temporarily reduced below the prescribed number, the chief of section will assign duties to best facilitate the service of the piece. Casualties and the loss of section personnel for various reasons may reduce the number of available personnel to such an extent that section members will have to double up on duties. Around-the-clock firing will require that the chief of section divide the section into shifts to provide for relief.

36. Verifies the Adjustment of the Sighting and Fire Control Equipment

The chief of section verifies the adjustment of sighting and fire control equipment in accordance with instructions presented in TM 9-1015-234-12. This manual is issued with each weapon, and it is the responsibility of the chief of section to become familiar with it.

37. Checks All Ammunition Prepared but not Fired Before It Is Stowed for Travel

The chief of section personally checks all ammunition that was prepared but not fired before it is replaced in the containers. He checks all time and VT fuzes that have been set to see that each has been reset to S, or to the shipping line.

Section III. DUTIES OF GUNNER

e. Sets or changes deflection.

f. Announces READY when the piece is ready to be fired.

g. Refers the panoramic telescope.

39. Centers the Pitch- and Cross-Level Bubbles on the Panoramic Telescope Mount

In all operations that involve the use of the panoramic telescope, the gunner centers the pitch- and cross-level bubbles on the telescope mount. The

step must be verified before the gunner calls READY.

40. Lays the Piece for Direction

The executive officer announces his intent to lay for direction by commanding BATTERY ADJUST, AIMING POINT THIS INSTRUMENT. After receiving the command, the gunner identifies the aiming point (usually the aiming circle) through the telescope and announces NUMBER (so-and-so) AIMING POINT IDENTIFIED. The executive commands NUMBER (so-and-so) DEFLECTION (so much). The gunner repeats the command, opens the door of the azimuth counter, and sets the deflection on the azimuth counter. He then traverses the piece until the reticle pattern of the telescope is centered on the objective lens of the aiming circle, insures that the pitch- and cross-level bubbles are centered, and announces NUMBER (so-and-so) READY FOR RECHECK. As additional deflections are commanded by the executive, the gunner repeats the commands, announces the difference in mils between the new deflection and the previously announced deflection as NUMBER (so-and-so) DEFLECTION (so much), (so many) MILS, and places the new deflection on the telescope using the procedures mentioned above. This process is continued until the executive announces NUMBER (so-and-so) IS LAID. When this is announced, the tube has been oriented and should not be traversed until an aiming point is established.

41. Direct Alinement and Realignment of Collimator and/or Aiming Posts

Assisted by a cannoneer, the gunner aligns the vertical reticle of the panoramic telescope with the zero line of the reference collimator or (when aiming posts are used) with the left edge of the aiming posts and resets the reset counter to 3200 to establish a common deflection. He records the reading on the azimuth counter before closing the window, since this reading reflects the angle required to place the tube parallel to the direction of fire. A detailed discussion of the alinement of aiming posts and the collimator is included in paragraph 81.

Section IV. DUTIES OF ASSISTANT GUNNER, CANNONEERS, AND DRIVER

46. Assistance Gunner

The assistant gunner sets and lays for quadrant, opens and closes the breech, and fires the howitzer on the command of the chief of section.

a. Sets and Lays for Quadrant. On the command

42. Sets a Common Deflection to a Common Aiming Point After the Piece Has Been Laid

When the piece has been laid, the executive may command AIMING POINT, CHURCH STEEPLE (or other point), REFER. At this command the gunner turns the telescope to the aiming point without moving the tube, records the deflection from the azimuth counter, and reports NUMBER (so-and-so), DEFLECTION (so much). The executive may record the referred deflection for future use, or he may command COMMON DEFLECTION 3200. At this command, the gunner depresses the azimuth counter reset knob and sets 3200 on the azimuth reset counter dial. He then makes a final check to verify that the line of sight is still on the aiming point and closes the window over the azimuth counter.

43. Sets or Changes the Deflection

The gunner sets the announced deflection on the reset counter and traverses the piece until the vertical crosshair of the reticle is on the left edge of the aiming posts, on the centerline of the collimator, or on a designated aiming point. The final movement of traverse is always from left to right.

44. Calls Ready

After the piece has been laid in both direction and elevation and has been loaded, the gunner calls READY to signify that the piece is ready to be fired.

45. Refers the Panoramic Telescope

The command is NUMBER (so-and-so) AIMING POINT THIS INSTRUMENT (or other point), REFER. Without disturbing the lay of the piece, the gunner turns the panoramic telescope until the vertical crosshair of the reticle is on the point designated and the pitch- and cross-level bubbles are centered. He then opens the door of the azimuth counter dial, reads the deflection on the azimuth counter, and reports to the executive NUMBER (so-and-so) DEFLECTION (so much).

QUADRANT, the assistant gunner sets the announced quadrant on the elevation counter with the elevation knob. He then elevates or depresses the tube until the longitudinal-level bubble is centered and he centers the cross-level bubble.

b. Opens and Closes the Breech. To open the breech the assistant gunner grasps the breech operating level handle with his left hand, depresses the handle, and draws it toward the rear. He closes the breech by pushing the operating handle forward with his left hand until the latch is engaged. After he has closed the breech, the assistant gunner verifies the elevation setting and the level of the bubbles and announces SET.

c. Fires the Howitzer. At the command and/or signal of the chief of section, the assistant gunner fires the howitzer with a quick strong pull on the lanyard.

47. Number 1 Cannoneer

The number 1 cannoneer loads the howitzer, recovers the expended cartridge case, and inspects the bore and chamber.

a. Loads the Howitzer. Number 1 receives the prepared round from number 3. Following all the safety precautions for handling ammunition, he grasps the base of the cartridge case with his right hand and grasps the projectile in front of the rotating bands with his left hand. On the command QUADRANT, he inserts the forward portion of the round in the breech, being careful to avoid striking the fuze against any part of the howitzer. When the quadrant is announced, he then pushes the round completely into the chamber with his right fist to protect his fingers from being crushed when the breechblock is closed. After loading the round, number 1 cannoneer remains inside the trail at the point of widest curvature on the left side to avoid possible injury from recoil during firing. He will not sit on the trails during firing, since the roller tire would yield and cause the quadrant setting to change. When firing a continuous fire mission, number 1 calls out the number and quadrant for each round as he loads it.

b. Recovers Expended Cartridge Case. As the breech is opened, number 1 recovers the expended cartridge case and throws it to the right rear of the howitzer out of the way of the section. To avoid moving into the path of recoil during firing, number 1 will not move to receive another round from number 3 until the howitzer has been fired.

c. Inspects Bore and Chamber. After each round is fired, number 1 inspects the bore and chamber to see that they are free of residue and announces BORE CLEAR.

48. Number 2 Cannoneer

The number 2 cannoneer fuzes or changes fuzes of

projectiles, sets fuzes with the appropriate fuze setter, and removes fuzes from projectiles.

a. Fuzes or Changes Fuzes of Projectiles. The number 2 cannoneer unscrews the fuze or closing plug from the fuze cavity of the projectile, inspects the cavity for rust and dirt, removes (or replaces) the supplementary charge if necessary, and screws in the designated fuze. Only authorized fuze wrenches should be used in tightening or loosening the fuze of the projectile. DO NOT HAMMER ON THE WRENCH OR USE AN EXTENSION HANDLE. If a time fuze is used and a safety wire is on the fuze, number 2 also removes the safety wire from the fuze and, if a booster is present, removes the safety pin from the booster.

b. Set Fuzes with Appropriate Fuze Setters.

(1) Time fuze M501 or M520.

(a) Mechanical time fuzes M501 and M520 normally are set with fuze setter M26. The number 2 cannoneer seats the upper lug of the fuze setter in the upper recess of the fuze and sets the announced time on the appropriate time band of the fuze setter. He places the handle of the fuze setter in a horizontal position and turns the handle counterclockwise until he feels a stop and hears a click. He raises the handle of the fuze setter, removes the fuze setter and verifies the time on the fuze before he passes the round to number 1. Point detonating (PD) action is obtained with M520 fuzes by firing them as shipped.

(b) When a functional M26 fuze setter is not available, the wrench-type fuze setter, M27, may be used. Number 2 engages the setter in the fuze notch and rotates it in the direction of increased readings until the time setting is opposite the index mark on the fuze.

(2) Time fuzes M563, M564, and M565.

(a) Time fuzes M563, M564, and M565 are set to an accuracy of 0.1 second with the M63 fuze setter. The impact setting for M564 fuzes is 90.0 seconds.

(b) The XM34 fuze wrench is a spanner wrench type of setter which can be used with the M563, M564, and M565 fuzes. Number 2 places the wrench on the fuze and turns the time ring to the desired setting to the nearest tenth of a second.

(3) Proximity variable time fuze, M513 series. Variable time (VT) fuzes are set with an M28 fuze setter using procedures very similar to those for using the M26 fuze setter. The number 2 cannoneer seats the stationary lug of the setter into the top recess of the fuze and places the announced setting on the fuze setter. He places the handle of the fuze setter in a horizontal position

and turns the handle clockwise until the setter stops or he hears a click. He then removes the fuze setter and verifies the fuze setting. When desired, PD action can be obtained with the M513A1 and M513A2 fuzes by setting 90.0 seconds on the fuze. No other fuzes of the M513 series can be set for PD action.

c. Combination Superquick and Delay Fuzes. The number 2 cannoneer must insure that the desired option on combination superquick and delay fuzes is alined with the slot on the setting sleeve of the fuze. To change the setting, he turns the setting sleeve with a screwdriver until the slot is alined with the option desired.

d. Removes Fuzes From Projectiles. If a fuzed projectile is not to be fired, number 2 removes the fuze from the projectile. The procedure for removing a fuze is just the reverse of that for inserting a fuze. If supplementary charges were removed, the number 2 cannoneer replaces them. He resets combination superquick and delay fuzes to SQ (superquick), resets time fuzes to S (safe) and replaces the safety wire if the fuze is so equipped, and resets VT fuzes to the initial setting as shipped; i.e., to S or O (depending on the model number). He then returns all fuzes to their containers and replaces closing plugs in the fuze cavities and projectiles.

49. Number 3 Cannoneer

The number 3 cannoneer prepares the propelling charge, assists in preparing the projectile, and passes the round to number 1.

a. Prepares the Propelling Charge. When the command CHARGE is announced, number 3 verifies the number of increments in the cartridge case and removes all increments having a higher number than that of the charge commanded. He hands the extra powder increments to number 4, who carries them to the powder pit and holds them in clear view of the chief of section until the round is fired.

b. Assists in Preparing Projectiles. After the powder charge has been cut, number 3, assisted by

number 5, fits the projectile into its cartridge case, being careful not to damage the lip of the cartridge case. Number 3 then holds the projectile upright while number 2 fuzes the projectile and sets the fuze. If requested, number 3 reads and announces the time set on the fuze.

c. Passes Round to Number 1. After the preparation of the round has been completed, number 3 places his left hand under the cartridge case and his right hand around the projectile and passes the complete round to number 1 so that he can grasp the round at the base of the cartridge case.

Note. DO NOT GRASP THE FUSE WHEN HANDLING AMMUNITION.

50. Number 4 and Number 5 Cannoneers

a. Number 4 cannoneer and number 5 cannoneer, working together, remove the ammunition from the fiber containers and arrange them within easy reach of number 3. They remove the tape from the cartridge end of the container with the container tilted so that the cartridge case can be taken by number 3. They then reverse the container and remove the tape from the other end. It is then tilted so that number 2 can receive the projectile. Number 4 then receives unused powder increments from number 3 and holds them over the powder pit until the round is fired. After the round is fired, number 4 drops the increments into the powder pit. The number 5 cannoneer also assists number 3 in his duties when possible.

b. All projectiles are inspected and cleaned by both cannoneers before firing. The rotating bands are examined for dirt and burrs and the entire projectile examined for defects. The projectiles are then stood on their ends and cleaned thoroughly. Any sand or dirt on the projectile will cause wear, scratches, or gouges in the bore.

51. Driver

The driver performs maintenance on his vehicle and performs any other duty prescribed by the chief of section.

Chapter 6

FIRING BY DIRECT LAYING

Section I. DIRECT LAYING TECHNIQUES

52. General

Firing by direct laying is a special technique that requires a high standard of training. The section must operate as an independent unit. Techniques of training in direct laying are the same as those for training in indirect laying. Targets taken under fire in direct laying usually are those capable of returning fire at pointblank range; therefore, speed and accuracy are even more important in direct laying missions than they are in indirect laying missions. For additional information on direct laying, see FM 6-40, FM 6-140 and table 4.

53. Range Card

a. The chief of section is responsible for the defense of his assigned sector. He should also be prepared to deliver fire in all sectors (directions).

b. During reconnaissance of the position or shortly after occupation of position, the chief of section should—

(1) Measure or estimate the ranges to prominent terrain features and likely avenues of approach.

(2) Establish reference points as required.

(3) Prepare a range card (fig 8).

(4) As time permits, improve the range card by replacing estimated ranges with more accurate ranges obtained by pacing, taping, odometer readings, map measurement, or survey.

c. The executive officer may assign numbers to certain prominent features to facilitate subsequent location of targets. As time permits, the chief of section should determine the deflection and quadrant for each numbered feature and enter this data on his range card. When a target is observed in the vicinity of one of the numbered features, the data on the range card expedites designation of the target and delivery of fire. The executive officer merely needs to announce, for example, TARGET THAT TANK, POINT NUMBER 2, FIRE AT WILL.

d. The field of fire of the section should, if possible, be cleared of obstructions that might hinder firing or observation. Care must be taken not to expose the location of the position.

54. Targets

Targets for direct laying usually consist of vehicles, tanks, and/or personnel threatening the battery. Enemy personnel, whether alone or accompanying tanks, will seldom present themselves as a clearly defined target. Normally, attacking troops will use all available cover in order to reveal themselves only fleetingly. Accordingly, fire is conducted on the area containing the attacking troops rather than on individuals. Tanks usually attack in a group and may be accompanied by infantry. Normally, first priority is given to attacking those targets within the assigned sector of the weapon, and second priority is given to targets in other sectors. Priority within the assigned sector or zone is given to—

a. Tanks at short ranges which are threatening to overrun the position.

b. Hull-down, stationary tanks covering the advance of other tanks.

c. The commander's tank, if it can be identified.

d. The tank nearest cover, which may disappear and reappear at unexpected places.

55. Methods of Direct Laying

a. *Sighting System.* The two-man, two-sight sighting system is used for direct laying with the M102 howitzer. The gunner lays for direction with the panoramic telescope, and the assistant gunner establishes range with the elbow telescope.

b. *Tracking the Target.* With lead and range established, continuous tracking of the target is maintained during the firing sequence.

56. Ammunition and Fuzes

a. *General.* A variety of ammunition is available

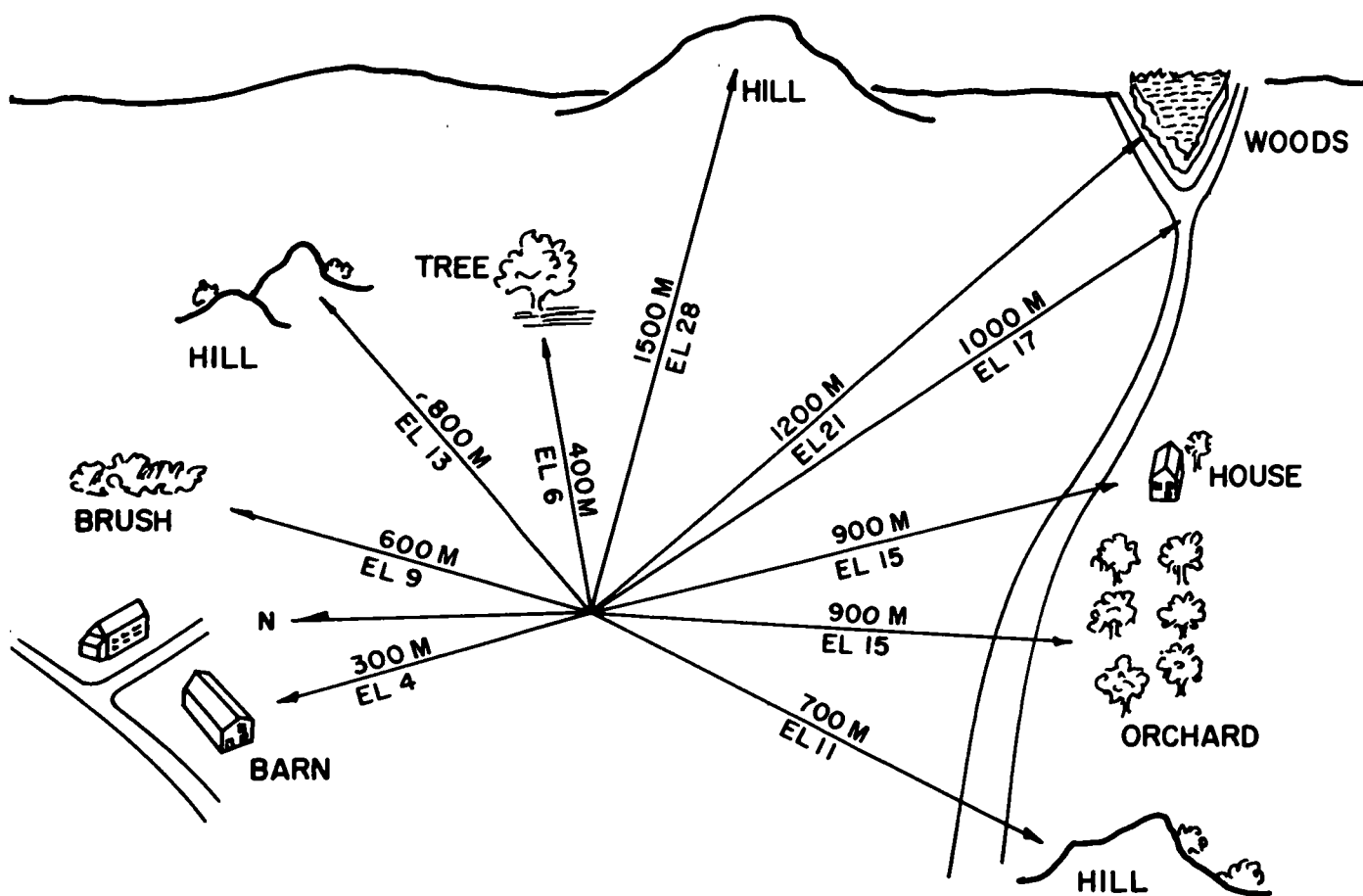


Figure 8. Range card for direct laying.

for close-in fires. When firing high-explosive shell, the highest charge is habitually used in order to speed the delivery of fire. However, if the weapon is dug in, the flat trajectory resulting from the use of the highest charge may make extremely close-in fires impractical; the fuze may fail to function and detonate the projectile on impact with the hard, flat ground. However, preparation of sectors of fire will remedy this situation. The terrain may be prepared for direct fire by placing "burster obstacles" such as mounds of sand, dirt, or logs in the sector of responsibility. When direct fire is placed on these points or other previously selected points as they are approached by an attacking force it reduces the necessity for adjusting fire.

b. Ammunition. High-explosive, plastic, tracer (HEP-T) projectiles were designed for use against tanks and armored vehicles and are highly effective against such targets. Shell XM546, commonly called Beehive, is ideally suited for antipersonnel fire and can be supplemented with high-explosive (HE) shell, which is effective against vehicles and tanks as well as personnel.

c. Fuzes. High-explosive shells may be fuzed with fuze quick, delay, time, concrete-piercing, or variable time. Fuze quick is the most desirable fuze to use for close-in fires. It is highly effective and is much faster to use, since no fuze setting is required. The time required to set the fuze and to adjust the point of impact for maximum ricochet effect makes fuze delay less desirable than fuze

quick. If fuze delay is used for ricochet effect, the point of impact is adjusted 10 to 30 meters short of the target; if less than 50 percent of the bursts ricochet, the fuze should be changed to fuze quick. Fuze time is not desirable for close-in targets because of the time required to prepare the round and because of the wide range dispersion resulting from variations in the time of burning with short fuze settings; therefore, fuze time should be used only for ranges greater than 1,000 meters. Fuze time M563 is used with beehive ammunition and,

as issued, is set for muzzle action. Concrete-piercing fuze with shell HE should be used against concrete pillboxes or fortifications.

57. Trajectories

Trajectory characteristics for different ranges must be considered before a target is taken under fire. Information contained in table 5 provides data on the effective direct fire ranges of the weapon.

Section II. DUTIES OF CHIEF OF SECTION

58. List of Duties

The chief of section—

- a. Conducts the fire of his piece.
- b. Identifies or selects the target.
- c. Estimates the range to the target.
- d. Determines the lead in mils.
- e. Announces initial commands.
- f. Announces subsequent commands.
- g. Commands END OF MISSION.

59. Conducts the Fire of His Piece

The chief of section conducts the fire of his piece when the executive officer commands TARGET (so-and-so), FIRE AT WILL or simply FIRE AT WILL. In direct fire the chief of section takes a post to the flank and slightly to the rear of the piece where his observation will not be obscured by the muzzle blast and smoke.

60. Identifies or Selects the Target

If the executive officer designates an object or one of a group of objects as the target, the chief of section then must identify the target. If the target is a group of objects, the chief of section must select the one that is the greatest threat to his position. He repeats the target identification to his section by using the minimum number of words; for example, LEAD TANK or MOVING TANK.

61. Estimates the Range to the Target

A range card (fig 8) with accurately measured ranges to key points provides the best means for determining the range to the target. If a range has not been prepared, the chief of section estimates the range.

62. Determines the Lead in Mils

The chief of section determines the appropriate lead in mils on the basis of the target's speed, direction of travel, range, and type of ammunition used. Approximate initial leads are as follows:

Target Speed (MPH)	Lead (mils)	
	Target traveling perpendicular to line of fire	Target traveling 45° to line of fire
5	5	5
10	10	5
15	15	10
20	20	15
25	25	15
30	30	20

63. Announces Initial Commands

The chief of section announces fire commands containing the following elements in the sequence indicated.

a. *Designation of Target.* The command is TARGET (so-and-so). Identification must be clear and unmistakable and should be expressed in the minimum number of words.

b. *Projectile, Charge, and Fuze.* The chief of section selects the appropriate projectile, charge, and fuze and commands SHELL (such-and-such), CHARGE (such-and-such) if applicable and FUZE (such-and-such).

c. *Lead.* The command is LEAD (so much). The chief of section determines the lead as indicated in paragraph 62.

d. *Method of Fire.* Fire is continuous unless otherwise commanded. In continuous fire, the piece is loaded and laid as rapidly as possible and fire at the command of the gunner.

e. *Range.* The command is RANGE (so much). The range commanded by the chief of section is

that range to be set on the sight reticle of the direct fire telescope.

64. Announces Subsequent Commands

a. The chief of section announces subsequent commands based on observed effects.

(1) *Change in lead.* During adjustment the lead in mils is changed by the command RIGHT (LEFT) (so much).

(2) *Change in range.* During adjustment the range is increased by the command ADD (so much) and is decreased by the command DROP (so much).

b. After the breechblock is closed, the chief of section gives further changes in firing data based on movement of the target during the time required for loading.

Section III. DUTIES OF THE GUNNER

65. List of Duties

The gunner—

a. Prepares the panoramic telescope.

b. Sets the proper lead on the azimuth counter and takes up the correct sight picture.

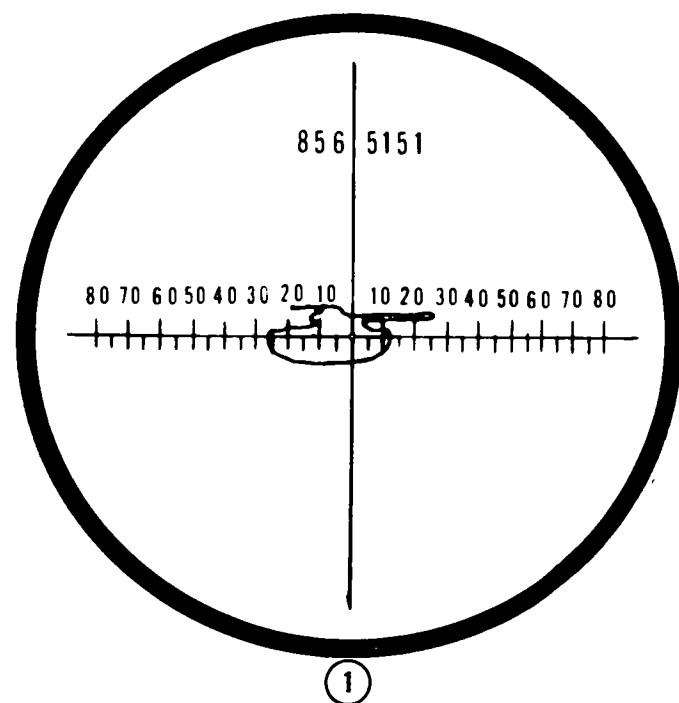
c. Commands FIRE.

66. Prepares the Panoramic Telescope

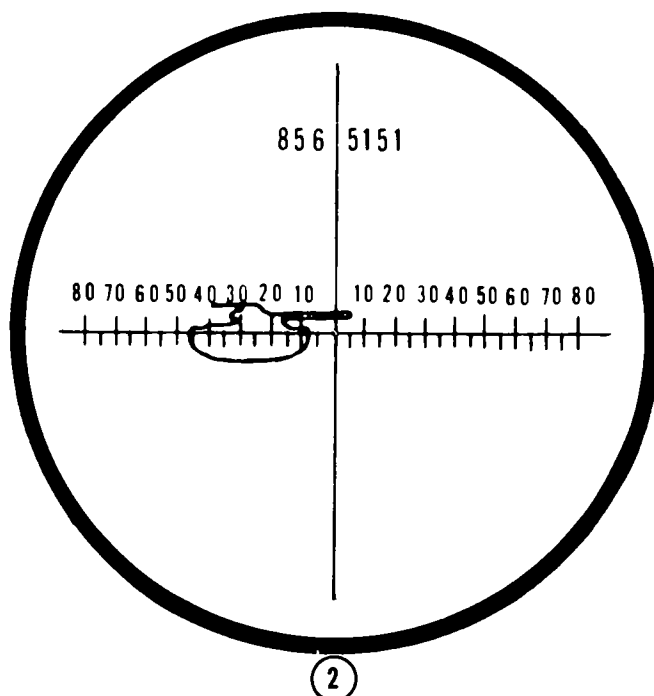
When direct fire is imminent, the gunner uncovers the window on the azimuth counter and sets the counter to 3200. He then turns the direct fire lead knob so that the word "direct" is visible, and centers the pitch- and cross-level bubbles.

67. Lays the Piece for Direction

a. The most accurate method of laying for direction in direct fire is by central laying. In this method, the gunner places the announced lead on the azimuth counter and traverses the howitzer until the vertical reticle is centered on the target as illustrated in ①, figure 9. With the assistance of the assistant gunner, the gunner continues tracking even after the round is fired. As the chief of section announces subsequent commands based on observed effects, the gunner sets any lead change by turning the azimuth knob in 5-mil increments. The click sight enables the gunner to make the appropriate change by sound and feel without moving his eye from the telescope eyepiece. He



①
POSITION OF VERTICAL LINE
IN CENTRAL LAYING



②
POSITION OF VERTICAL LINE
IN RETICLE LAYING

Figure 9. Gunner's sight pictures for central laying and reticle laying.

continues to maintain his sight picture with the vertical reticle centered on the mass of the target.

b. A less desirable method of laying is by reticle laying. The preparation of the sight in this method is the same as that in central laying except that the lead is set by placing the vertical line of the reticle the proper number of mils ahead of the center of the target (②, fig 9). The gunner contin-

ues to track in this manner until the target is destroyed or until the chief of section issues a subsequent fire command.

68. Commands Fire

When the gunner is ready, he will give the command FIRE for each initial and subsequent round as soon as the assistant gunner announces SET.

Section IV. DUTIES OF THE ASSISTANT GUNNER

69. List of Duties

The assistant gunner—

- Prepares the elbow telescope.
- Lays the piece for range and calls SET.

70. Prepares the Elbow Telescope

In preparation for direct fire the assistant gunner centers the cross-level bubble and checks the functioning of the range gageline.

71. Lays the Piece for Range

The assistant gunner lays the piece for range by sighting through the direct fire telescope. He

moves the range line up and down in the reticle until the line is on the announced range on the proper ammunition scale. The assistant gunner then elevates or depresses the tube until the target intersects the range line as shown in figure 10. He maintains the correct sight picture through continuous tracking and continues to call SET as long as the weapon is laid on the target. After a round is fired, the chief of section announces subsequent commands based on the observed effects. The assistant gunner corrects the sight picture to apply any range changes commanded and continues in the normal sequence as indicated above.

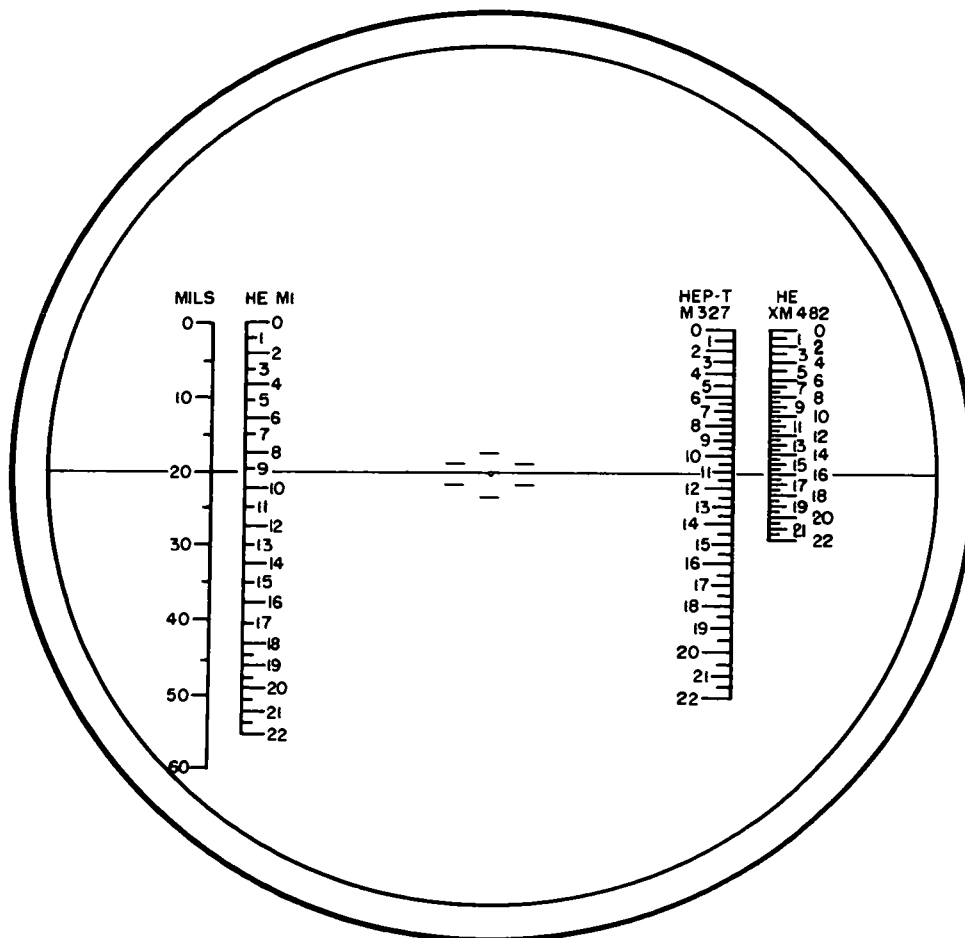


Figure 10. Assistant gunner's sight picture for range, direct fire telescope.

Section V. DUTIES OF THE CANNONEERS

72. Duties of the Remainder of the Section

The number 1 cannoneer loads the weapon while standing inside the howitzer trails on the right side. So that he will not be in the path of recoil during the continuous tracking and subsequent

firing of the piece, the number 1 cannoneer fires the howitzer when the gunner commands **FIRE**. He also opens and closes the breech. The duties of numbers 2 through 5 and the driver in direct laying are the same as those for indirect laying.

Chapter 7

SPECIAL OPERATIONS

Section I. AIRMOBILE OPERATIONS

73. General

The M102 howitzer can be used in airmobile operations without modification or disassembly. The weapon can be air landed, air dropped and transported internally or externally by a helicopter.

74. Responsibilities

a. Air-Landed Operations. The unit commander is responsible for delivering the weapon and its associated equipment to the transport aircraft. Loading, positioning, and tiedown of the equipment are performed under the direction of the aircraft commander.

b. Air Delivery Operations. The rigging of equipment for air delivery is accomplished by the section under the supervision of especially trained parachute maintenance personnel. Derigging in

the drop zone is accomplished by the howitzer section.

c. Helicopter Transport. Rigging of equipment for external transport by helicopter is the responsibility of the unit commander and is performed by the howitzer section. Specially trained helicopter personnel can be (and often are) requested to supervise the rigging of the equipment and to inspect the loads. Loading for internal transport by helicopter is performed under the direction of the aircraft commander.

75. Rigging for External Loads

The equipment required and the procedures to be followed in preparing and hooking up an external load for an airmobile operation are described in TM 55-450-11.

Section II. RIVERINE OPERATIONS

76. General

Riverine operations are normally conducted in swampy, marshy terrain and thus require waterborne artillery. For such operations the M102 howitzer is mounted on a barge or paddy platform.

77. Use of Barges

Two M102 howitzers can be mounted on a 90- by 30-foot barge. Each barge is towed into position by an LCM-8 (mechanized landing craft). It is positioned against the bank so that panoramic telescopes can be laid by normal methods from the bank and aiming posts or collimators can be placed on the bank to provide fixed references. The fire direction center (FDC) for a barge-mounted battery can be located in the well deck of one of the landing craft used to transport the barges; the executive officer's post is usually lo-

cated on the center barge. Wire communication is established between the FDC to the executive officer's (XO) post and between the XO post and the howitzers for the transmission of fire commands.

78. Use of Paddy Platform

The airmobile firing platform also can be used in riverine operations to provide a land firing base for light artillery. A paddy platform for an M102 howitzer generally is constructed of aluminum and wood. The platform can be employed in up to 4 feet of water or mud. Each platform can support one M102 howitzer and crew and approximately 120 rounds of ammunition. The platform usually is emplaced by a medium helicopter. The emplacement area is not critical provided the platform is not positioned on a slope that exceeds the cant correction limits of the howitzer on the platform.

Chapter 8

TECHNIQUES AND SITUATIONS THAT REQUIRE SPECIAL ATTENTION

79. Precision in Laying

a. Fire control instruments, fuze setters, and elevation and traverse mechanisms must be operated in a manner that will reduce the effects of lost motion. For uniformity and accuracy the last motion in setting the instruments must be from lower to higher numbers, the final motion of the elevating handwheel must be in the direction of more difficult movement, and the final motion in traversing must be from left to right. Personnel who lay the piece must be required to verify the laying after the breech has been closed.

b. The line of sight for setting and reading a scale or centering a bubble should be at a right angle to the scale or level vial to prevent errors.

c. For uniformity and accuracy in the initial lay on aiming posts or a collimator, the vertical cross-hair of the panoramic telescope reticle must be aligned with the left edges of the aiming posts or the centerline of the collimator. The procedures for subsequently re-laying the weapon when there is piece displacement are discussed in the following paragraphs.

80. Aiming Points

After the howitzer has been laid for direction, it is referred to a collimator and/or aiming posts and usually to one or more distant aiming points as described in paragraph 42. An aiming point must have a sharply defined point or vertical line which is clearly visible from the piece so that the cross-hairs of the panoramic telescope can be aligned on exactly the same point each time the piece is re-laid.

81. Use of Aiming Points

a. *Infinity Aiming Reference Collimator M1.*

(1) *Description.* The collimator (fig 11) is an optical instrument which simulates an azimuth reference target at infinity and is used for indirect laying of artillery weapons.

(a) The mounting base is a mechanical as-

sembly consisting of a tripod and a yoke subassembly which houses the azimuth and elevation controls. The tripod supports the collimator at a normal height of 3 feet above the ground and is leveled by extending or retracting the hinged tripod legs. The azimuth clamping knob directly below the yoke is used to clamp the azimuth mechanism. The elevation yoke allows the collimator to be adjusted plus or minus 850m in the vertical plane. The elevation clamping knob located near the top of the yoke is used to operate the elevation clamping mechanism.

(b) The collimator assembly consists of an optical system, a mechanical housing, and a light source. The reticle pattern is essentially an azimuth reference scale repeated at vertical intervals to form a grid throughout the collimator field of view. The reticle pattern can be cross-leveled by rotating the entire collimator assembly about the optical axis. A cylindrical cross-level vial attached to the collimator serves as a reference in cross-leveling. A cross-level clamping knob near the center of the collimator permits rotation of the collimator for cross-leveling and locks the collimator in place after it has been cross-leveled. Open sights on the collimator assembly permit rapid alinement of the optical system with the panoramic telescope sight of the weapon.

(c) The M1 collimator is equipped with a light source for illuminating the reticle pattern at night. This light is controlled at the piece by the gunner.

(d) When not in use, the collimator optics are protected by a cover made from fiber glass reinforced plastic. The cover is equipped with a carrying handle and is attached to the collimator by three snap latches. A strap restrains the tripod legs when they are folded.

(2) *Operation.* The collimator has replaced aiming posts of the M1 series as the primary reference from which deflection angles are measured. After the weapon has been laid for direction, the collimator should be positioned 4 to 12 meters to the left rear of the weapon at a deflection between

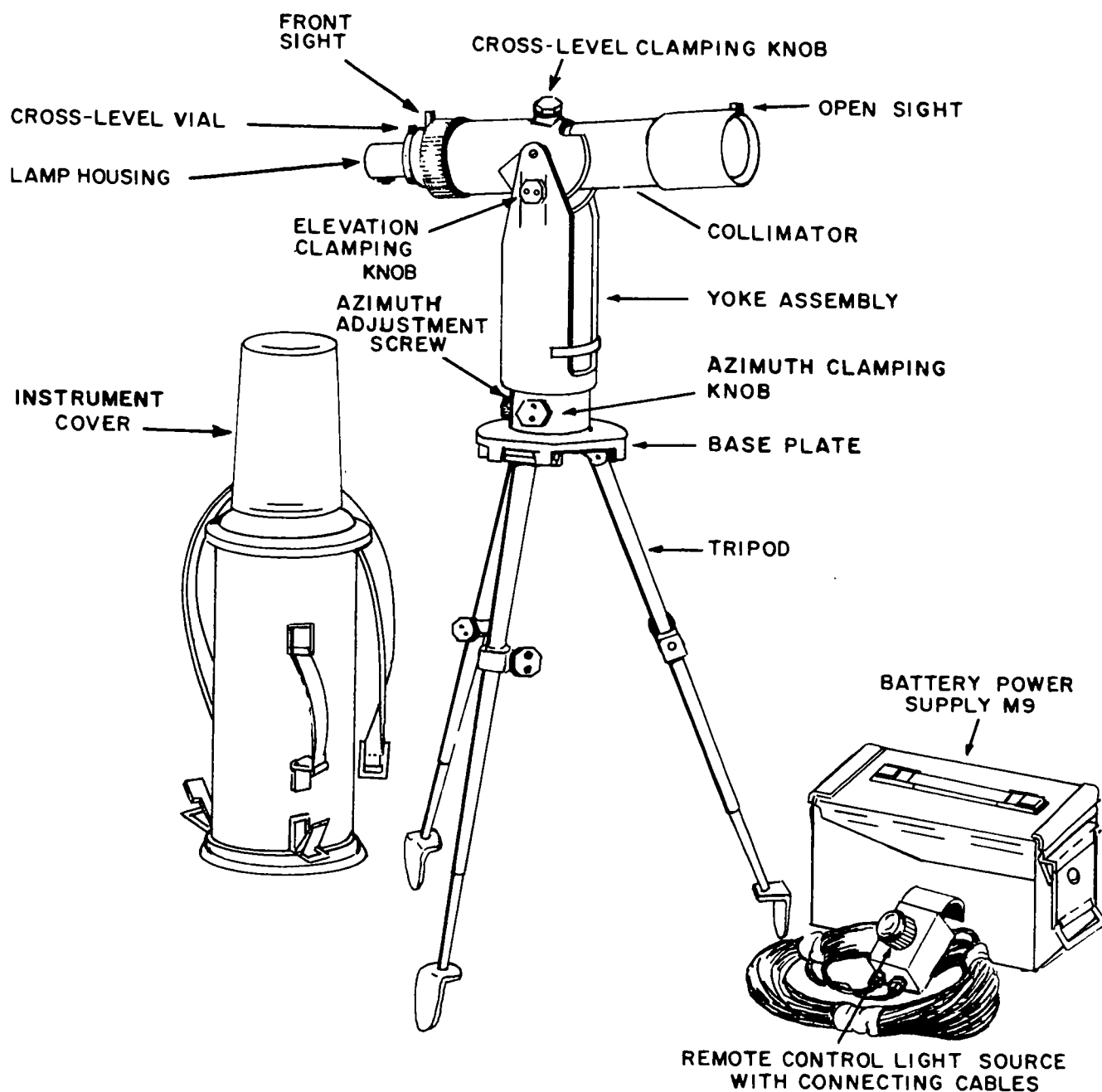


Figure 11. Infinity aiming reference collimator.

400 and 800 mils. This will permit maximum use of the collimator and still maintain a 6400-mil firing capability.

(a) *Setting up the collimator.* The number 1 cannoneer sets up the collimator. The procedure is as follows:

1. Loosen the strap on the instrument cover assembly and open the latches between the cover end and the collimator base. Depress the tripod legs, then open the latches and remove the cover.

2. Set the tripod legs into the ground as

nearly level and as firmly as possible consistent with the situation and the time available. Precise leveling is not necessary since the reticle can be cross-leveled separately.

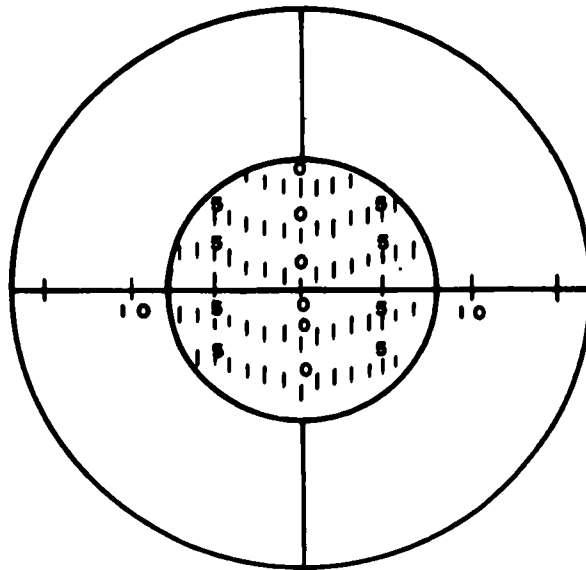
3. Loosen the azimuth and elevation clamping knobs. Sight through the front and rear sights and move the collimator until the optical system is sighted on the panoramic sight of the weapon.

4. Release the collimator clamping knob. Refer to the cylindrical cross-level vial on the collimator, and rotate the collimator until the bubble

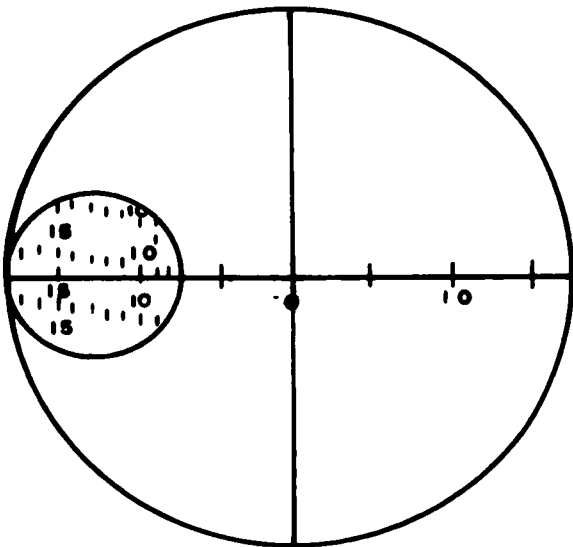
is centered in the vial. The reticle pattern then will be level.

(b) *Laying and referring.* After the collimator has been set up and alined with the panoramic telescope of the weapon, tighten the elevation and azimuth clamping knobs. The gunner's sight picture should appear as shown in 1, figure 12, provided there is no displacement. Each significant number (numbered graduation) in the reticle pattern represents 5 mils; each short vertical graduation on the V-format of the reticle represents 1 mil. For accurate laying and referring, the

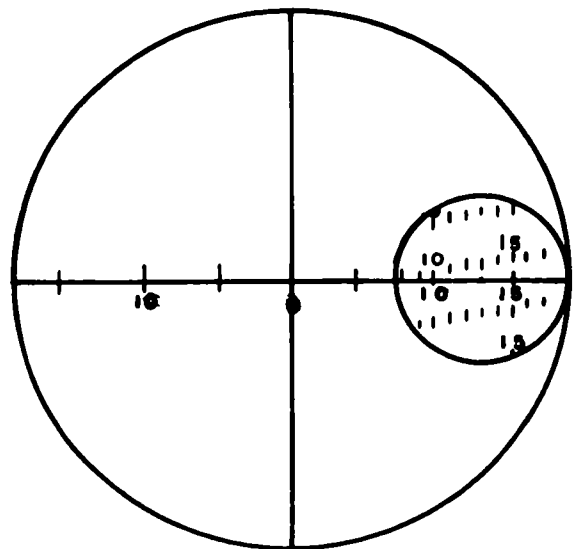
gunner should be able to see two significant numbers or at least a 7-mil sector of the reticle pattern. The V-format of the reticle pattern, together with the numerals on the reticle, indicate the direction and amount of displacement of the weapon. A reticle pattern that slopes upward from right to left indicates right displacement; a pattern that slopes upward from left to right indicates left displacement. The amount and direction of displacement can be determined even if only a small portion of the pattern is visible. To correct for displacement, the gunner sights on the collima-



INITIAL ALINEMENT
(1)



RIGHT DISPLACEMENT
(2)



LEFT DISPLACEMENT
(3)

Figure 12. Gunner's sight picture of collimator when correcting for displacement

tor and matches the reticle of his panoramic telescope with the collimator reticle pattern. For example, if the numbers 10 and 15 appear in the reticle pattern and the pattern slopes upward from right to left (right displacement), he matches the left portion of the panoramic telescope reticle with the collimator reticle pattern as shown in 2, figure 12; if the reticle pattern slopes upward left to right (left displacement), he matches the right portion of the panoramic telescope reticle with the collimator reticle pattern as shown in 3, figure 12.

(3) *Care and handling.*

(a) Stops on the instrument limit elevation and depression of the collimator. The operator should not attempt to force the collimator beyond the stop limits.

(b) The collimator should be covered and protected from dust and moisture when it is not in use.

(c) The collimator assembly should not be pointed directly at the sun unless a filter is used because the focused rays could damage the optical elements.

(d) All exposed surfaces must be kept clean and dry to prevent corrosion and/or etching of optical elements.

(e) Instrument knobs should not be forced beyond their limit of motion.

b. Aiming Posts.

(1) Two aiming posts are used for each howitzer. Each post is equipped with a light for use at night. At least 100 meters between the piece and the far aiming post is the most desirable distance for good visibility and for accurate laying and firing. The far aiming post is set up first and alined with the vertical crosshair of the panoramic telescope. The near aiming post is then set up halfway between the far aiming post and the panoramic telescope and is alined by the gunner so that the vertical crosshair of the telescope and the left edges of the two aiming posts are in alinement. To insure equal spacing of aiming posts, the distance from the piece to each aiming post should be paced by the same man. If ground conditions make pacing inaccurate, the distances from the piece to the aiming posts can be measured by using the panoramic telescope as discussed in (4) below.

(2) The collimator is used as a primary aiming point. Aiming posts are used only if no collimator is available or to assist in maintaining a 6,400-mil firing capability. When used as an alternate aiming point, aiming posts normally are emplaced to the front at a deflection between 3000

and 3400 mils. The number 1 cannoneer emplaces the aiming posts to be used as a substitute for the collimator, and the number 4 cannoneer emplaces the aiming posts to be used as an alternate aiming point.

(3) When the aiming posts are used at night, the light on the far aiming post should be placed so that it appears above the light on the near aiming post. On flat terrain this can be accomplished by using only the lower half of the near aiming post. The two lights placed in this manner will establish a vertical line for laying the piece.

(4) Equal spacing of the aiming posts can be accomplished by using the aiming post as a stadia rod and by using the panoramic telescope as a measuring device. When setting out the aiming posts, the number 1 cannoneer holds the upper section of one of the aiming posts parallel to the ground and perpendicular to the line of sight. The gunner measures the length of the aiming post in mils on the reticle of the panoramic telescope. For example, the upper section of an aiming post is $4\frac{1}{2}$ feet long and measures 14 mils on the reticle when the post is 100 meters from the piece—the point at which the far aiming post is emplaced. The proper location for the near aiming post would be the point at which the $4\frac{1}{2}$ -foot section measures 28 mils on the reticle. In many cases, the ideal spacing of the posts at 50 and 100 meters from the piece will not be possible, but the aiming posts will be properly spaced when the near aiming post is set at a point at which the $4\frac{1}{2}$ -foot section of the post measures twice the number of mils it measured at the far aiming post location. This measurement can be performed at night by attaching the night lighting devices at the $4\frac{1}{2}$ -foot marks on the aiming posts.

c. Distant Aiming Point. A distant aiming point is one at sufficient distance to insure that the normal displacement of the piece in firing or traverse will not cause a horizontal angular change in direction of more than one-half mil. This distance should be at least 1,500 meters. The executive officer usually designates the distant aiming point or points to be used.

82. Correction for Displacement

a. Collimator. To aline the howitzer parallel to its original orientation after the weapon has displaced during firing, the gunner simply traverses the howitzer until a reticle match is obtained as discussed in paragraph 81a.

b. Aiming Posts. When the gunner notes that the vertical line of the telescope is displaced from the line formed by the two aiming posts, he lays

the piece so that the far aiming post appears exactly midway between the near aiming post and the vertical crosshair (fig 13). If the displacement was caused by traversing the piece, the gunner continues to take up the sight picture as described above. If the displacement resulted from some other cause, such as progressive shifting of the carriage, the gunner notifies the chief of section, who, at the first lull in firing, will notify the executive and request permission to realine the aiming posts. For realinement of the aiming posts, the piece is first laid with the far aiming post midway between the near aiming post and the vertical crosshair (fig 13). The far aiming post then is moved into alinement with the vertical crosshair of the telescope, and then the near aiming post is alined with the far aiming post and the panoramic telescope. If it is impracticable to move one of the two aiming posts because of the terrain, the piece is relaid for direction and referred to the aiming post that cannot be moved. The other post is then alined and the azimuth counter is reset.

83. Check Firing

The command CHECK FIRING is normally given to the section by the chief of section; however, in an emergency anyone present may give the command. At this command, regardless of its source, firing is halted immediately. If the piece is loaded, the chief of section reports that fact to the executive officer. The executive officer acknowledges this by repeating the announcement. If CHECK FIRING is commanded by the fire direction center, firing is resumed at the command of CANCEL CHECK FIRING, QUADRANT (so much). If CHECK FIRING is announced from the firing battery area, the executive officer investigates to determine the condition that caused the command to be given. When the condition has been corrected, firing is resumed at the executive officer's command of CANCEL CHECK FIRING, QUADRANT (so much).

84. Changes in Data During Firing

a. If an incorrect command has been announced but FIRE has not been commanded, CORRECTION and then the correct command all subsequent elements are announced. If the piece is not loaded, the new data are set off and firing is resumed when the quadrant is announced.

b. If FIRE has been announced, the executive officer announces CHECK FIRING. He then announces CANCEL CHECK FIRING and gives the correct command and all subsequent elements. Firing continues with the announcement of QUADRANT (so much). If the piece is loaded

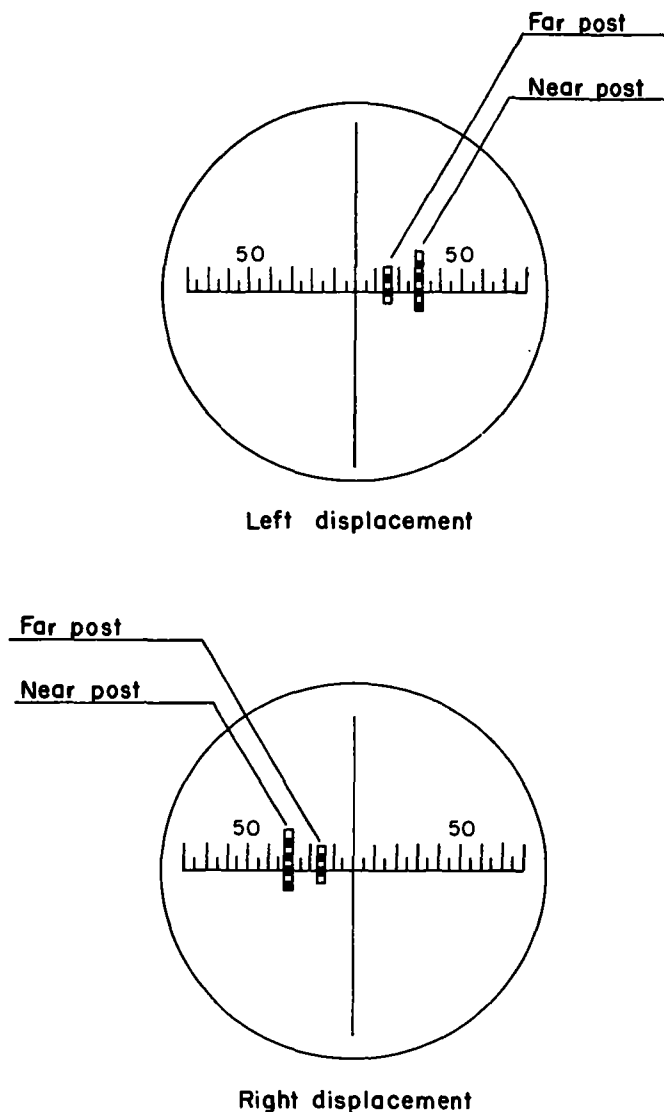


Figure 13. Sight picture of aiming posts to correct for displacement.

with a time-fuzed projectile and a change is required in the fuze setting, the chief of section suspends firing and reports that fact to the executive; for example, NUMBER (so-and-so) LOADED, TIME (so much). The piece will not be unloaded unless directed by the executive.

c. In continuous fire, changes in data are applied without stopping the fire or breaking its continuity.

85. To Unload the Howitzer

a. Once a complete round is loaded, it should be fired. However, if unloading is required, the command UNLOAD is announced.

b. If the howitzer has been fired repeatedly and the tube is hot, the weapon should be fired if possi-

ble. If it is necessary to unload the weapon, it must be unloaded within 5 minutes from the time it was loaded or the safety procedures described in chapter 14 must be followed.

c. Unloading will be supervised by an officer. The procedure for unloading a round that has not been in a hot tube in excess of 5 minutes is as follows:

(1) The assistant gunner opens the breech slowly.

(2) Number 1, standing at the breech, receives the ejected round.

d. If the extractor fails to eject the cartridge case, the procedure is as follows:

(1) Number 2 obtains the rammer staff and the unloading rammer head.

(2) The officer inspects the rammer head to insure that it is free of obstructions.

(3) Number 2 inserts the rammer into the bore until the head encloses the fuze and touches the projectile.

(4) Number 2 then pushes on the rammer and taps the end of the staff lightly with a wooden block, if necessary, until the round is dislodged.

(5) Number 1 receives the round as it is pushed out of the breech.

e. If the cartridge case is extracted but the projectile is not, the unloading procedure is as follows:

(1) Number 1 fills the powder chamber with waste and closes the breechblock.

(2) Number 2 dislodges the projectile as described in *d* above.

(3) Number 1 opens the breech, removes the waste and receives the projectile as number 2 pushes the projectile to the rear.

86. Care of Ammunition

Great care must be exercised in handling and storing ammunition to insure uniform results in firing, to prolong the life of the tube, and to avoid accidents. The following precautionary measurements should be taken.

a. Information presented in TM 9-1300-206 that is applicable to field service should be followed.

b. Ammunition must be protected from damage.

(1) Raise ammunition stacked in the open 6 inches off the ground, and dig drainage ditches around the stacks.

(2) Use tarpaulins and dunnage to protect ammunition from weather, dirt, and the sun.

(3) Allow a 6-inch airspace between the top of the stack and the covering tarpaulin.

(4) Leave ammunition and components in containers until just before firing to protect them from moisture.

Note. Uniform propellant temperatures must be maintained to insure accurate firing.

c. Explosive elements in fuzes are particularly sensitive to shock and high temperature; therefore, the following precautions should be observed:

(1) Protect fuzes from weather, direct sunlight, and rough handling.

(2) Do not remove protective and safety devices from fuzes until just before firing.

(3) Do not attempt to disassemble a fuze.

d. Ammunition should be protected from hostile fire by—

(1) Dispersing ammunition in small stacks.

(2) Storing ammunition in trenches and dug-outs.

(3) Insuring that each stack of ammunition does not contain more than 75 rounds and is not more than four layers high.

(4) Placing stacks of ammunition at least 10 meters apart.

e. Ammunition should be sorted and stored by lots.

f. For further information on care of ammunition, see FM 6-40, TM 9-1015-234-12, TM 9-1300-203 and TM 9-1300-206.

Chapter 9

~~BASIC PERIODIC TEST~~

cl 1

Boresighting

Section I. GENERAL

87. Description

a. Boresighting is the process of verifying that the optical axis of the on-carriage fire control instruments are parallel to the axis of the tube of the weapon. Any misalignment detected through boresighting must be corrected as described in the following paragraphs. Boresighting is conducted before firing and during lulls in firing when the howitzer fires inaccurately for no apparent reason.

b. There are four methods of boresighting in M102. The method to be used will be determined by the unit SOP and the time available. These methods are as follows:

- (1) Testing target method (para 91-93).
- (2) Distant aiming point method (para 94-96).
- (3) Aiming circle method (para 97-99).
- (4) Standard angle method (para 100-102).

88. Equipment

The following equipment is needed for boresighting.

a. *Boresights.* Front and rear boresights are necessary for all methods except the standard angle method of boresighting. If front boresights are not available, crosshairs may be fastened on the muzzle.

b. *Testing Target.* A testing target (fig 14) provides accurate aiming diagrams for the tube, the panoramic telescope, and the elbow telescope. The testing target is prepared as follows:

- (1) Mount the target on a flat piece of material and fasten it to a stand to provide stability.
- (2) Inscribe a mil scale at the bottom of the target for use in either leveling or canting the testing target. Place a small nail at the top of the target to mark the center from which the mil scale arc was drawn and to provide a hook from which to suspend the plumbline.

(3) Draw a vertical reference line through the center of each diagram. When the trunnions are not level, these lines can be used to cant the target the same amount and in the same direction as the carriage.

(4) To facilitate boresighting in darkness, bore a 1/16-inch hole through the center of each aiming diagram and cover each hole with a piece of heavy cloth. A flashlight held against the cloth provides an aiming point for use in blackout conditions. The cloth should be attached to the back of the target to completely cover each hole so that light from the flashlight will not escape. The flashlight should not be lit until after it is firmly in position. Care must be taken to prevent disturbing the position of the testing target.

(5) If the proper testing target is not available, a substitute may be constructed in accordance with the dimensions shown in figure 14.

c. *Tools.* Section equipment includes all necessary tools for boresighting and testing.

Caution: Use the proper tools to prevent damage to fire control equipment.

89. Conditions for Correct Alinement

The on-carriage fire control instruments are in correct alinement when the following conditions exist.

- a. Mounts and instruments are securely attached and there is no binding or excessive backlash between the gears.
- b. The line of sight of on-carriage sighting instruments are parallel to the axis of the bore throughout the limits of elevation.
- c. The elevation counter dial reading is 0.
- d. The azimuth counter dial reading is 3200.

90. Leveling

Although it is not absolutely necessary to level the trunnions for boresighting, it is advisable to do so

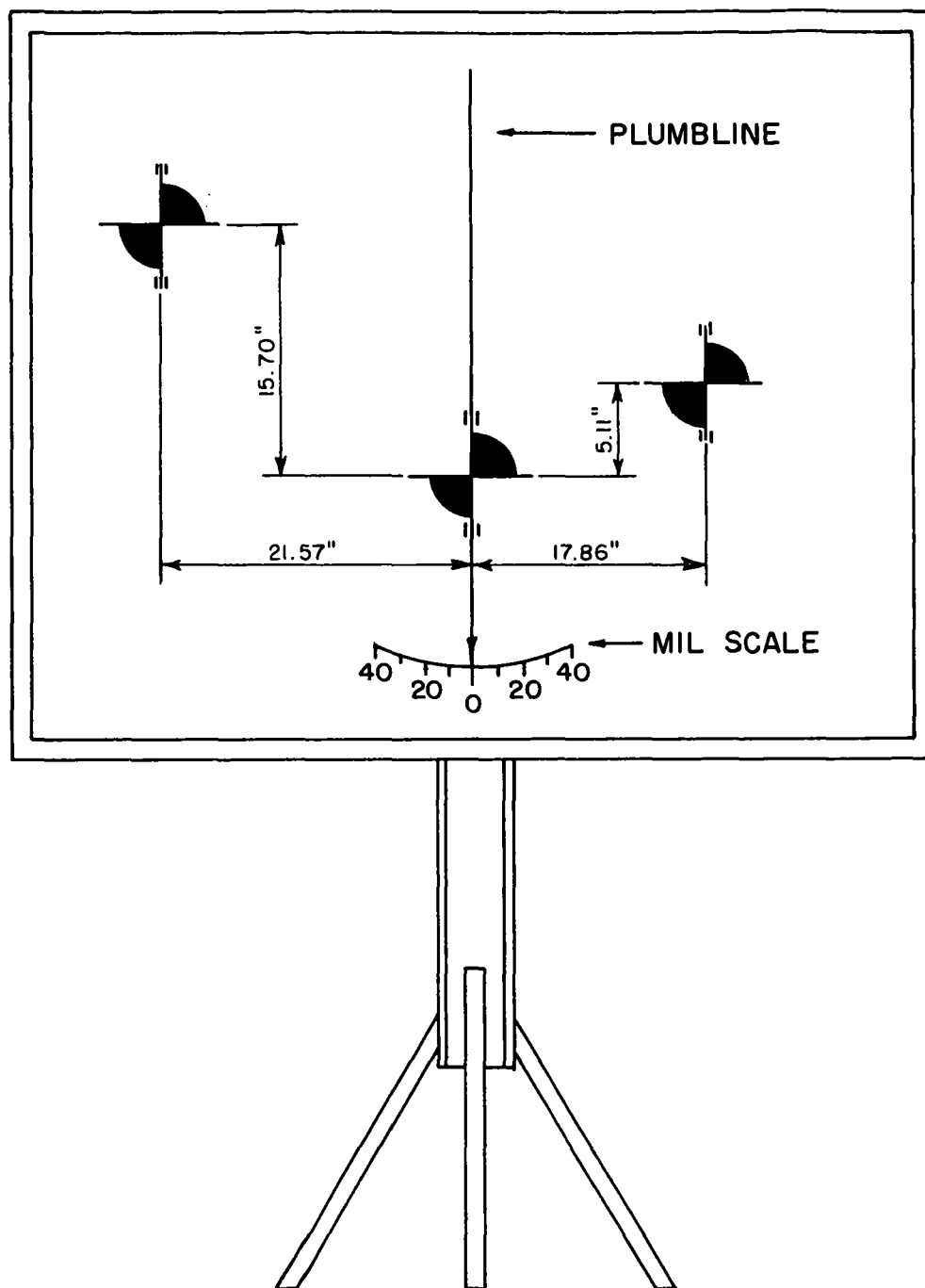


Figure 14. Testing target.

whenever possible. Accurate results can be obtained more readily if the trunnions are level, since the telescope mount and the testing target, when it is used, do not have to be tilted to correspond to the cant of the trunnions. The trunnions can be leveled by jacking up one of the axes as necessary. Leveling can be checked with a plumbline or a gunner's quadrant.

a. *Plumbline.* The best method to check leveling of the trunnions is by means of a plumbline. The

line is suspended so that the muzzle of the howitzer can be placed as close to the line as possible. The weapon should be placed on jacks to permit adjustment. When the trunnions are level, the vertical hairline of the front boresight should remain in coincidence with the plumbline as the tube is elevated through its limits. (The plumbline should be long enough to permit elevating the tube to at least 1,100 mils.) If coincidence is not maintained throughout elevation of the tube, adjust the

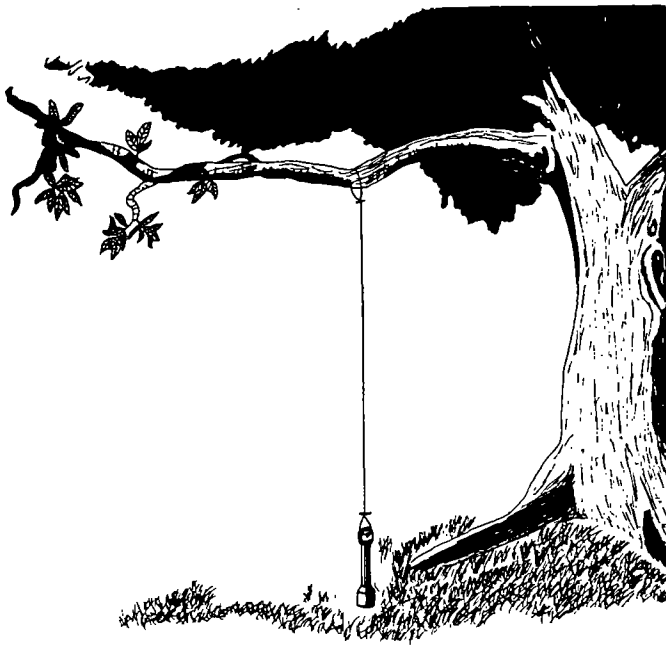


Figure 15. Plumbline suspended from a tree.

jack until coincidence is maintained. The plumbline must be shielded from wind currents, and the plumb bob or weight should be suspended in a container of liquid in order to keep the plumbline steady (fig 15).

b. Gunner's Quadrant. In leveling operations in which the gunner's quadrant is used, a quadrant that has been tested and proved to be accurate is required. The gunner's quadrant is placed on the breechblock leveling pads that are perpendicular to the long axis of the tube, and the low axle is jacked up until the bubble on the gunner's quadrant is centered.

Section II. TESTING TARGET METHOD

91. General

The testing target method consists of alining the lines of sight of the tube, the panoramic telescope, and the elbow telescope with the aiming diagrams on the testing target.

92. Preparations for Boresighting

Preparations for boresighting are as follows:

- a. Place the howitzer on level ground.
- b. Install the rear boresight disk and mount crosshairs on muzzle witness marks.
- c. Level the trunnions as described in paragraph 90.
- d. Set the tube at zero elevation by using a gunner's quadrant and applying corrections, the end-for-end test, and the imbedded corrections.
- e. Center the pitch- and cross-level bubbles on the panoramic telescope mount.

93. Boresighting Procedures With Testing Target

With the weapon prepared as described in paragraph 92, boresight as follows:

a. Testing Target Location. Position the testing target at least 50 meters in front of the howitzer.

b. Testing Target Alinement. Without moving the tube, aline the center aiming diagram of the testing target with the line of sight through the tube. The testing target must be placed perpendicular to the axis of the bore. *The testing target then must be made secure.*

c. Panoramic Telescope Alinement.

- (1) Set the gunner's aid counter to 0.
- (2) Adjust the azimuth and elevation knobs on the panoramic telescope to lay the reticle precisely on the left aiming diagram.
- (3) Insure that—
 - (a) The muzzle crosshairs are centered on the center aiming diagram.
 - (b) The telescope mount is level.
- (4) Check the azimuth counter of the panoramic telescope; it should read 3200 mils. If the reading is not 3200 mils, turn the boresight adjustment shaft until 3200 appears in the counter window.

d. Elbow Telescope Alinement. After the procedures prescribed in *c* above have been performed—

(1) Center the cross-level bubble.

(2) Position the range gageline of the elbow telescope on zero elevation.

(3) Determine if the reticle of the elbow telescope coincides with the right pattern of the testing target. If the reticle does not coincide with the

target pattern, turn the adjusting screws on the mount until the reticle and the target pattern coincide.

(4) If the telescope reticle cannot be brought into coincidence with the testing target pattern, the mount must be adjusted by support maintenance personnel.

Section III. DISTANT AIMING POINT METHOD

94. General

The distant aiming point method consists of aligning the lines of sight of the tube, the panoramic telescope, and the direct fire telescope on a distant aiming point.

95. Preparations for Boresighting

a. Select a well-defined point at a distance of at least 1500 meters.

b. Follow the preparatory procedures prescribed for the testing target method (para 92).

Note. Accurate leveling of the trunnions is not manda-

tory for boresighting on a distant aiming point because the lines of sight converge on a single point.

96. Boresighting Procedures With Distant Aiming Point

a. Lay the line of sight of the tube on the distant aiming point.

b. Lay the reticles of the panoramic telescope and the direct fire telescope on the distant aiming point with the same sight picture observed through the telescopes and through the tube.

c. Adjust the telescopes as required.

Section IV. AIMING CIRCLE METHOD

97. General

The aiming circle method may be used to boresight the weapon for direction during daylight, darkness, or periods of reduced visibility.

98. Preparation for Boresighting

a. Prepare the weapon for boresighting as indicated in paragraph 92.

b. Set up an aiming circle to the front of the weapon at a distance of 30 to 50 meters.

99. Boresighting Procedures With Aiming Circle

a. Lay the line of sight of the tube on the aiming circle objective lens or reflector.

b. Lay the vertical hairline of the aiming circle

on muzzle of tube with the instrument reading 3200 (lower motion).

c. With the upper motion, refer the aiming circle to the objective lens of panoramic telescope sight.

d. Announce the reading on the aiming circle to the gunner.

e. Set the announced reading on the azimuth counter.

f. Adjust the vertical hairline of the panoramic telescope onto objective lens or reflector of the aiming circle by using the azimuth knob.

g. Set the announced deflection of the azimuth counter by depressing and turning the boresight adjustment shaft.

Section V. STANDARD ANGLE METHOD

100. General

When combat conditions make the other methods of boresighting impracticable, the standard angle method may be used. In this method, the alignment of the optical axis of the panoramic telescope parallel to the axis of the bore is tested and ad-

justed by referring to a selected point on the muzzle. The deflection and elevation angles necessary to refer the line of sight of the telescope to the selected point on the muzzle are known as standard angles. After the standard angles have been determined, they can be used for a quick test of the

alinement of the panoramic telescope when more precise methods cannot be used. Alinement corrections made as a result of this test should be verified by a more accurate boresighting method at the earliest opportunity. When the standard angle method of boresighting is used, the recoiling parts must be in the same position with respect to the nonrecoiling parts as they were when the standard angles were determined. Therefore, before the standard angle method of boresighting is used, the recoil mechanism must be checked to see that it contains the proper amount of recoil oil. Standard angles are usable only as long the tube-carriage combination is intact. If either the tube or carriage is changed, new standard angles must be established.

101. Preliminary Operations

The ideal time to determine the standard angles for latter use is after basic periodic tests have been performed, when the trunnions are level, and the panoramic telescope mount is known to be in correct alinement. The procedure for determining standard angles is as follows:

a. With the tube in battery, scribe lines in the paint to mark the normal positions of the parts which move in recoil with respect to parts which do not move in recoil.

b. Boresight the piece by using a testing target.

c. With tape, fasten a bright, straight pin in the left horizontal witness mark on the muzzle. Allow the pin to project to the left of the muzzle.

d. Position the parallax shield over the eyepiece of the panoramic telescope.

e. Verify that the elevation counter dial is at 0 and that the telescope mount is level.

f. Turn the azimuth knob and elevate or depress the tube as necessary to place the crosshairs of the

sight on the pin in the left horizontal witness mark of the tube.

g. Verify that the telescope mount is level and that the intersection of the horizontal and vertical crosshairs of the telescope is exactly on the junction of the pin with the muzzle.

h. Read and record the deflection from the azimuth counter dial of the panoramic telescope to the nearest one-fourth mil. This will be the standard azimuth angle for the piece tested.

i. With the gunner's quadrant seated on the quadrant seats, measure and record the elevation of the tube to the nearest one-tenth mil. This will be the standard elevation angle for the piece tested.

102. Boresighting Procedure

a. After the standard angles have been determined and recorded, the standard angle method of boresighting is performed as follows:

(1) Verify that the parts that move in recoil are in the same position with respect to the nonrecoiling parts as they were when the standard angles were determined.

(2) With tape, fasten a bright straight pin in the left horizontal witness mark so that the pin projects to the left of the muzzle.

(3) Close the parallax shield.

(4) Set off the standard elevation angle (para 101*a*).

(5) Set off the standard azimuth angle on the azimuth counter dial of the panoramic telescope (para 101*h*).

b. If the intersection of the crosshairs of the panoramic telescope is not exactly on the junction of the pin and the muzzle, the sight is out of adjustment. If the azimuth angle is in error, section personnel can correct the sight rotating the bore-sight adjustment shaft.

Chapter 10

~~BORESIGHTING~~

Basic Periodic Tests

Section I. GENERAL

103. Purpose and Scope

a. The purpose of this chapter is to describe the procedures for performing basic periodic tests of on-carriage fire control equipment. The procedures covered include only those tests that may be accomplished at battery level. Using units normally will not have the necessary facilities, tools, or skilled personnel to perform the more precise tests and adjustments of sighting and fire control equipment. If an elevation counter, a telescope mount, or a panoramic telescope is in error in excess of the tolerance authorized on any of the tests outlined, the piece and/or panoramic telescope must be sent to support maintenance for adjustment.

b. Basic periodic tests are performed by the section under the supervision of the battery executive, chief of firing battery, and artillery mechanic. These tests are performed at the discretion of the unit commander. Suggested times for these

tests are once each year if the piece is used for nonfiring training; once every 3 months if the piece is fired; as soon as possible after extensive use, following accidents, or traversing extremely rough terrain; and whenever the piece fires inaccurately for no readily apparent reason. The tests will reveal whether the on-carriage sighting equipment, the gunner's quadrant, and the fuze setters (M26 and M28) are in correct adjustment.

104. Preparations for Basic Periodic Tests

The following preparations must be made before basic periodic tests are conducted.

a. Place the howitzer on a site that is as nearly level as possible.

b. ~~Suspend a plumbline (para 90a).~~ *See Ch 1*

c. Level the trunnions by using a plumbline.

C d. Boresight the howitzer by using the testing target method. *See Ch 1*

Section II. TESTS OF GUNNER'S QUADRANT

105. General

The gunner's quadrant *must* be in proper adjustment before tests and adjustments of other sighting and fire control equipment can be made.

106. End-for-End Test

The end-for-end test is conducted as follows:

a. Inspect the shores of the gunner's quadrant for dirt, nicks, and burrs.

b. Inspect the quadrant seats on the howitzer for dirt, nicks, and burrs.

c. Zero the scales on the gunner's quadrant.

d. Place the quadrant on the quadrant seats on the breech ring with the line-of-fire arrow pointing toward the muzzle. Depress and elevate the tube until the bubble in the gunner's quadrant is centered.

e. Reverse the quadrant on the seats and check the bubble. If the bubble recenters itself, the quadrant is in adjustment and the test is complete.

f. If the bubble does not recentre, turn the micrometer knob and try to center the bubble.

(1) If this adjustment centers the bubble, read the black figures on the micrometer scale and divide by 2. *The result will be the correction for the gunners' quadrant.*

(2) Place this correction on the micrometer scale and level the tube.

(3) Reverse the quadrant. The bubble should center.

g. If the adjustment described in f above does not center the bubble, move the gunner's quadrant arm down 1 graduation (10 mils) and perform the following operations:

(1) Turn the micrometer knob until the bubble centers.

(2) Take the reading on the micrometer scale, add 10 to it, and divide the sum by 2. Place the result on the micrometer scale.

(3) With the quadrant arm set at minus 10 and the result from (2) above set on the micrometer scale, place the quadrant on the quadrant seats and use the elevating handwheel to level the tube.

(4) Reverse the quadrant. The bubble should center.

(5) If the bubble is centered, subtract the reading on the micrometer scale from 10 to obtain the error.

Note. If an error is determined during the end-for-end test, the correction will be used only during the sighting tests and adjustments and will not be applied in fire missions. If the error determined exceeds 0.4 mil, the quadrant must be sent to direct support maintenance.

107. Micrometer Test of the Gunner's Quadrant

The micrometer test is performed as follows:

a. Set the radial arm to a reading of 10 mils on the elevation scale, and set the micrometer at 0.

b. Place the quadrant on the quadrant seats with the line-of-fire arrow pointing toward the

muzzle, and center the quadrant bubble by elevating the tube.

c. Set the radial arm at 0, and set the micrometer at 10 mils. Place the quadrant on the quadrant seats. The bubble should center.

Note. Do not disturb the lay of the tube.

d. If the bubble does not recenter itself, the micrometer is in error and must be adjusted by direct support maintenance personnel.

108. Comparison Test of the Gunner's Quadrant

The comparison test is conducted in the following manner:

a. Compare the readings taken at low, medium, and high elevations with each gunner's quadrant in the battery on the quadrant seats of a single piece.

b. Compute the average reading for each elevation.

c. Compare the reading taken with each gunner's quadrant with the average for each elevation.

d. Any gunner's quadrant which indicates a reading that differs from the average by more than 0.4 mil must be adjusted by direct support maintenance personnel.

Section III. TESTS OF ON-CARRIAGE FIRE CONTROL EQUIPMENT

109. Purpose

The purpose of testing the telescope mount, the telescope, and the elevation quadrant is to determine whether the azimuth counter and level vials actually establish the tube (regardless of cant) in the correct vertical plane at all elevations. These tests are performed to check the adjustment and mounting of the panoramic telescope mount, the accuracy of the level vials, and the alinement of the telescope socket. ~~The test of the telescope mount described in paragraph 110 can be performed with the trunnions either level or canted.~~ The test reflects the total errors in the entire mechanism. Because of compensating errors in various parts of the mount, this test could erroneously indicate that the mount is properly adjusted. For this reason, the other tests specified in paragraphs 111 and 112 must be performed regardless of the result of the test described in paragraph 110. The total errors detected in these tests then may be reduced to errors in specific components.

110. Test of Telescope Mount

The azimuth and vertical alinement tests of the telescope mount are conducted as follows:

a. With the boresights in place and the tube at a low elevation, traverse the tube so that the line of sight through the tube is on the plumbline and level the telescope mount by centering the pitch- and cross-level bubbles.

b. Place the intersection of the crosshairs of the panoramic telescope reticle on any sharply defined aiming point and note the deflection.

c. Elevate the tube from minimum to maximum elevation (or limit of the plumbline) on 100-mil steps. At each step, traverse the tube (if necessary) to bring the line of sight back on the plumbline. Relevel the telescope mount in both directions and check for deviation of the line of sight from the aiming point. If the vertical crosshair is off the aiming point, use the azimuth knob to realine the reticle on the aiming point. If the horizontal

crosshair is off the aiming point, use the elevation knob to realine the reticle on the aiming point, and note the bubble displacement.

d. If the vertical crosshair deviates from the aiming point by more than one-half mil from the original deflection at any elevation tested or if the correction for the deviation of the horizontal crosshair causes either level bubble to move in excess of one-half vial graduation, the telescope mount is out of adjustment or improperly mounted. Refer the weapon to direct support maintenance personnel for adjustment or corrections.

111. Test of Cross-Level Vial, Telescope Mount

a. Level the telescope mount by centering the pitch- and cross-level bubbles.

b. Set the line of sight of the panoramic telescope at 3200 with the parallax shield in place.

c. Suspend a plumbline to coincide with the vertical crosshair of the telescope reticle.

d. Turn the elevation knob of the panoramic telescope through the entire range of movement. If the line of sight deviates from the plumbline by more than one-half mil, the cross-level vial is out of adjustment and must be adjusted by direct support maintenance personnel.

112. Test of Longitudinal-Level Vial, Telescope Mount

a. Level the telescope mount by centering the pitch- and cross-level bubbles.

b. With the parallax shield in place, turn the azimuth knob of the panoramic telescope and set the line of sight to 1,600 mils.

c. Suspend a plumbline to coincide with the vertical crosshair of the panoramic telescope reticle.

d. Turn the cross-level knob on the telescope mount through the entire range of movement. If the line of sight deviates from the plumbline by more than 1 mil, the longitudinal-level vial must

be adjusted by direct support maintenance personnel.

113. Test of the Panoramic Telescope

a. Set the azimuth counter dial at 3200.

b. Traverse and elevate the tube as necessary to place the panoramic telescope reticle on an aiming point.

c. Rotate the telescope head through a complete circle (6,400 mils). The telescope reticle should return to within 1 mil of the aiming point.

114. Test of Elevation Counter and Fire Control Quadrant M14

Using a gunner's quadrant that has been checked for accuracy, measure the elevation of the tube at low, medium, and high elevations by placing the gunners' quadrant on the quadrant seats on the fire control quadrant M14 and centering the bubble in the gunner's quadrant. At each elevation, turn the elevation knob until the elevation level bubble is centered and insure that the cross-level bubble is centered. Compare the readings of the elevation counter with the reading on the gunner's quadrant at each elevation. If the readings on the two instruments do not agree and the amount of disagreement is the same at all elevations, the appropriate correction is applied to the elevation correction indicator dial. If the magnitude of disagreement between the readings varies with the elevation of the tube, the elevation counter is out of adjustment and must be referred to support maintenance personnel.

115. Test of Weapon Cant

When the trunnions of a weapon are canted the azimuth will change when the weapon is elevated. The cant corrector XM4 is used as a cant measuring device to determine the number of mils of cant in the weapon at different elevations. See TM 9-1015-234-12 for specific instructions on the use of the XM4 cant corrector.

Section IV. TEST OF FUZE SETTERS

116. General

Examine the fuze setters as follows:

a. Check the following for burred or dented edges:

(1) The stop that fits into the slot of the movable time ring.

(2) The adjusting pawl which engages the notch in the fixed fuze ring.

b. Depress the adjustable pawl against its spring to insure that the movement of the pawl is free.

c. Compare the fuze setter with the fuze for

which it was designed to insure that the graduations on the fuze setter time scale are the same as those on the fuze time ring.

117. Time Scale Test

The time scale test is a comparison of the time set on the fuze with the time setting on the fuze setter. The time set on the fuze should agree with the time setting on the fuze setter within one-fourth of the smallest graduation on the fuze time ring. For example, the tolerance on a fuze having 0.5-second graduations is 0.125. This test can be conducted during firing or as a separate test.

Warning: Never use a fuse from a dud.

a. Place a time setting on the fuze setter and set a fuze. Compare the two settings. If the fuze setting does not agree with the time set on the fuze setter, proceed as follows:

(1) Repeat the test with a different setting.

(2) If the time set on the fuze and the time setting on the fuze setter still do not agree, refer the instrument to direct support maintenance.

b. When the test is complete, reset all fuzes to S (safe) and replace the safety wire or cotter pin in each fuze.

Chapter 11

MAINTENANCE AND INSPECTIONS

118. General

Systematic maintenance and inspection are essential to insure that—

- a. The howitzer section is prepared to carry out its mission immediately.
- b. An unexpected breakdown is not experienced at a critical time when maximum performance is essential.
- c. Expensive and time-consuming repairs are reduced to a minimum.

119. Disassembly, Assembly, and Adjustment

Authorized adjustments and disassemblies to be performed by battery personnel are prescribed in TM 9-1015-234-12. Deviation from these procedures is not authorized except that permitted by the responsible ordnance officer.

120. Records

Operational, maintenance, and historical records pertaining to the weapon will be prepared and maintained as prescribed in TM 38-750.

121. Maintenance

Detailed instructions for maintaining the howitzer are presented in TM 9-1015-234-12. Maintenance instructions for the prime mover are contained in the appropriate technical manuals and lubrication orders.

122. Inspection

- a. The *chief of section* should inspect his equipment *daily*. If he sees a need for repair or adjustment, he notifies the battery executive immediately so that necessary action will be taken.
- b. The *executive*, accompanied by the chief of firing battery and the artillery mechanics, should

make a *daily informal command inspection* of different parts of the weapon and carriage.

- c. The *executive* should make a thorough mechanical inspection of the weapons, auxiliary equipment, tools, and spare parts *at least* once a month.

- d. *Battery, battalion, and higher commanders* should make frequent command inspections to assure themselves that the equipment in their commands is being maintained at prescribed standards of appearance, condition, and completeness.

123. Operational Services

Each day a vehicle or weapon is *operated*, the crew must inspect and service the vehicle or weapon as follows:

- a. *Before-operation service* is a brief inspection to determine if the howitzer and vehicle, when appropriate, are ready for operation. At this time the chief of section verifies that sufficient ammunition, rations, tools, and equipment are available and have been secured. Specific duties of section members are listed in table 6.

- b. *During-operation service* consists of detecting any unsatisfactory performance of the vehicle or howitzer.

- c. *After-operation service* prepares the vehicle and howitzer for operation at a moment's notice. This is the basic daily service of the vehicle and howitzer, and it is particularly important for the purpose of detecting any deficiencies which may have developed during operation. All defects that the driver and crew cannot remedy must be reported at this time. The chief of section will resupply ammunition and rations as required and will verify that all equipment is present. Specific duties of personnel in after-operation service are listed in table 7.

Chapter 12

DECONTAMINATION OF EQUIPMENT

124. General

Equipment that has been contaminated with chemical, biological or radiological agents constitutes a hazard to personnel and must be removed or neutralized. The spreading of an injurious agent can affect persons, objects, and terrain. The process of covering, removing, or destroying a contaminating agent or changing the agent into a harmless substance is referred to as decontamination. Generally only equipment contaminated by persistent agents needs to be decontaminated.

125. Decontamination for Chemical Agents

a. Ammunition. Ammunition, especially the brass parts, contaminated with chemical agents usually will corrode. Wipe off the visible contaminant with rags. Use a DANC (decontamination agent, noncorrosive) solution or its future replacement DS2 to decontaminate ammunition contaminated with a liquid blister agent or V-agent. Then, wipe ammunition with a solvent-soaked rag and dry. If neither DS2 nor DANC solution is available, wash ammunition with cool, soapy water; then rinse and dry. Slurry (equal weights of water and chloride of lime) can be used on contaminated ammunition containers, but it must not be allowed to seep into the ammunition itself. DS2, warm soapy water, or aeration in sun or warm air will effectively decontaminate G-agents. A DANC solution cannot be used for decontamination of these particular agents.

b. Optical Instruments. Decontamination of glass, plastic, and rubber requires a great deal of care. In general, instruments should be decontaminated by blotting off the contaminant, wiping the items with solvent, and then allowing them to aerate. Some plastics can be decontaminated by using a rag dampened with DANC, drying the material with a clean rag, and then applying a coat of machine oil. DANC solutions affect transparent plastics and rubber and cannot be used on these materials; however, DS2 can be safely used on plastics and rubber if it is rinsed off with clear water after 30 minutes.

c. Weapons. Remove dirt, dust, grease, and oil from weapons. Do not apply wet mix but allow surfaces to air after oil and dirt have been removed. DS2 or DANC solution can be used on all metal surfaces except the bore. Firing the weapon is the recommended method for decontamination of the bore; however, if this is not practical, the bore can be decontaminated with cleaning solvent or hot soapy water. After decontamination, weapons are dried and oiled.

d. Automotive Equipment. Vehicles only lightly contaminated with chemical agents can be decontaminated by aeration. For heavy contamination, use DANC or DS2 solution on interior and exterior surfaces that personnel are likely to touch. For large areas of decontamination, wash vehicle with water and scrub painted surfaces with soap and water.

126. Decontamination for Biological and Radiological Agents

a. General. After a contaminating attack, equipment can be decontaminated either by waiting to permit the decay of contamination or by using active decontamination measures to reduce the contamination to a level at which it is no longer a significant hazard to operating personnel. Decontamination may be either rough or detailed, depending on the urgency of the military situation. The procedure adopted will be a command decision.

b. Rough Decontamination. Rough decontamination is performed when urgency is the main factor. Its purpose is to reduce contamination sufficiently to permit personnel to work with, or close to, contaminated equipment for limited periods. Rough decontamination can be achieved by means of water or steam, if available. Soap or other detergents used in conjunction with water or steam aids in decontamination.

c. Detailed Decontamination. Detailed decon-

tamination, in which the emphasis is on thoroughness, will be carried out in rear areas and repair bases and includes procedures of surface decontamination, aging, sealing, and disposal.

127. References

For further information on decontamination see FM 21-40, TM 3-220, and Training Film 3-3753, Unit CBR Decontamination.

Chapter 13

DESTRUCTION OF EQUIPMENT

128. General

a. Tactical situations may arise in which equipment must be abandoned in a combat zone. In such a situation all equipment must be destroyed to prevent its use by the enemy.

b. *Equipment will be destroyed only on the authority delegated by a division or higher commander.*

129. Plans

A plan will be prepared by each battery to expedite destruction of equipment in order to reduce the time required should destruction become necessary. The principles to be followed in the destruction of equipment are as follows:

a. Plans for the destruction of equipment must be adequate, uniform, and easily executed.

b. Destruction must be as complete as possible.

c. Priorities must be established so that the more essential parts of each weapon are destroyed first by each section of a battery. The same essential parts must be destroyed by all sections to prevent the enemy from reconstructing equipment from undamaged parts.

d. Priorities for destroying spare parts and accessories will be the same as those for destroying corresponding parts and accessories installed on equipment.

130. Methods

a. The most generally applicable methods of destruction are—

(1) *Mechanical*—Requires axes, picks, sledges or similar equipment.

(2) *Burning*—Requires gasoline, oil, or other flammables.

(3) *Demolition*—Requires ammunition or explosives.

(4) *Gunfire*—Requires artillery, rocket launchers, rifle grenades, or hand grenades.

b. In general, destroying essential parts and then burning the entire weapon will be sufficient to render the weapon useless.

131. Reference

Detailed information on destruction of the equipment is contained in TM 9-1015-234-12.

Chapter 14

SAFETY PRECAUTIONS

132. General

Safety precautions to be observed in training are prescribed in AR 385-63. Additional information on safety is presented in FM 6-40, FM 6-140, TM 9-325, and TM 9-1900. The more important safety precautions are summarized in this chapter.

133. Ammunition

The following precautions must be observed when handling ammunition:

- a. Store ammunition in the firing area so that it is protected against accidental explosions.
- b. Keep fire and flammable materials out of the area. There will be no smoking in the vicinity of ammunition.
- c. Protect ammunition from direct rays of the sun.
- d. Do not disassemble fuzes.
- e. Prevent rough handling of projectiles, cartridge cases, and fuzes, and do not strike projectiles and cartridge cases together.
- f. Check all ammunition prepared for firing but not fired to insure that—

(1) Appropriate powder increments are present, in proper order, in good condition, and of the proper lot number.

(2) The lot number of the ammunition corresponds to the lot number on the container.

(3) Time fuzes have been reset to safe and the safety wires have been replaced, that VT fuzes have been reset to the initial setting in which they were shipped, and that combination superquick and delay fuzes have been reset to SQ.

134. Misfires

a. In the event that a weapon fails to fire when the tube is cold, make two more attempts to fire by activating the firing mechanism. If the weapon still fails to fire, wait 2 minutes from the last attempt to fire and then open the breech and remove

the cartridge case. If the primer is dented, replace the cartridge case and fire the weapon. If the primer is not dented, repair the firing mechanism, replace the cartridge case, and fire the weapon.

b. In case of a misfire of a round in a hot tube, the safety procedures are the same as those followed when the tube is cold. However, if the weapon cannot be fired or unloaded within 5 minutes, the following precautions must be followed:

(1) Remove the cartridge case provided 2 minutes have elapsed since the last attempt to fire and the round has not been in the chamber for 5 minutes.

(2) Elevate the tube to a safe elevation, preferably to approximately 550 mils.

(3) Evacuate all personnel to a safe distance.

(4) Allow the weapon to cool for 2 hours.

(5) After the 2-hour waiting period, move the weapon to a remote position if necessary for safety. Request direct support maintenance personnel for assistance if required. If relocation is necessary, lower and lock the tube in travel position. Before closing the breech, place waste in the chamber to cushion the projectile and to protect the face of the breechblock in case the projectile falls back while the weapon is being moved. Release the weapon to ordnance personnel.

c. For detailed procedures refer to TM 9-1015-234-12.

135. Drill and Firing

a. Load the weapon only when firing is imminent. If a round which has been loaded in a hot tube cannot be fired within 5 minutes, follow the unloading procedures described in paragraph 134b.

b. Personnel moving from one side of the weapon to the other must move in rear of the piece.

c. Personnel must stand clear of the muzzle and the path of recoil.

d. Crewmembers should use earplugs or cotton to protect eardrums during firing.

e. A safety officer will be present during all firing in training exercises. Specific duties for the safety officer are listed in FM 6-40.

f. At least *two* stakes must be emplaced prior to firing the howitzer with charges up to and including charge 6. Additional stakes should be emplaced as soon as possible. The total number of

stakes to be emplaced depends on the soil and is determined by the chief of section. In firing charge 7, *all* 8 stakes should be emplaced before the howitzer is fired except in an emergency.

g. The number 1 cannoneer must remain inside the trails during firing and closely adhere to his duties as specified in chapters 5 and 6 for direct and indirect firing. This precaution must be taken to prevent possible injury of the number 1 cannoneer or to other members of the section.

Chapter 15

TRAINING

Section I. GENERAL

136. Purpose

The purpose of this chapter is to present the requirements for training section personnel in the performance of their duties in service of the piece. This chapter includes general information on the conduct of training and tests for gunner's qualifications.

137. Objectives

The objectives of training are to speed the attainment of proficiency by cannoneers in their individual duties and, by means of drill, to weld the section into an effective, coordinated team, capable of functioning efficiently in combat. During training, the supervisor should keep in mind the proficiency goals established by the appropriate Army training test (ATT).

138. Conduct of Training

a. Training requirements are prescribed in AR 611-201, ATP 6-100, FM 6-125, and FM 21-5.

b. Individual training is conducted by noncom-

missioned officers so far as practicable. Battery officers are responsible for preparing training plans, for conducting unit training, and for supervising and testing individual training.

c. Throughout training the application of prior instruction to current training must be emphasized.

d. The chief of section should maintain progress cards to indicate the training received by each individual in the section. Each card should reflect periods of instruction attended and tests taken by the individual concerned and remarks pertaining to his progress. The chief of firing battery and the battery executive should inspect progress cards frequently to make sure that they are being kept properly and to determine the state of training.

e. The training should be oriented to insuring that each member of the section knows the duties of all other members and can perform efficiently in each duty station. It should also constantly emphasize the necessity for developing leadership and initiative in the noncommissioned officers.

Section II. MINIMUM TRAINING SCHEDULE

139. Individual Periods

a. Individual periods of training in service of the piece should be scheduled along with other battery training to form a balanced training program which follows the basic principles of training.

b. Except for service practice, periods on any subject generally should not exceed 1 hour. Section drill periods should not exceed one-half hour and should be conducted in a vigorous manner.

c. Each drill period should be preceded and fol-

lowed by training periods on subjects that are logically related to the drill. For example, a period of drill should be preceded by a period of testing and adjustment of sighting and fire control equipment and followed by a period of inspection and maintenance drills. A period on aiming post and/or collimator displacement correction may be scheduled between two periods of howitzer drill.

d. The training schedule outlined in table 8 is a guide to meet the minimum training requirements for personnel of a howitzer section in subjects covered in this manual.

Section III. GUNNER'S QUALIFICATION TESTS

140. Purpose and Scope

This section prescribes the tests to be given in the qualification of gunners. The purpose of the tests is to—

a. Determine the relative proficiency of the *artillery soldier* in performing the duties of gunner for a 105-mm howitzer M102, light, towed. *The tests are not a basis for determining the relative proficiency of batteries or higher units.*

b. Serve as an adjunct to training.

141. Standards of Precision

The candidate will be required to meet the following standards in completing the tests:

a. Counter settings must be exact.

b. Bubbles must be centered exactly.

c. The vertical crosshair in the reticle of the panoramic telescope must be alined on the left edge of the aiming posts or on the same part of the aiming point or target each time the howitzer is laid. When a collimator is used, the numbers on the panoramic telescope must coincide exactly with the corresponding numbers on the collimator reticle.

d. *Final motions* must be made in the appropriate direction.

(1) *Counter settings* are made from lower to higher numbers.

(2) *Elevation* should be in the direction of the more difficult movement.

(3) *Traverse* is in the direction of left to right.

(4) *The vertical crosshair* of the panoramic telescope is moved from left to right.

142. Assistance

a. The candidate will receive no unauthorized assistance.

b. The candidate may select assistants as authorized in the tests.

c. If an assistant or the examiner causes the candidate to fail a test, the test will be disregarded and another test of the same nature will be administered.

143. Time

a. The time allowed for each test is the time

from the last word of the command to the last word of the candidate's report.

b. The candidate may begin the test after the first word of the first command.

144. Scoring

a. Scoring will be in accordance with the paragraphs entitled "Penalties" and "Credit" for each test.

b. No penalty in excess of the maximum credit allowed will be assessed for each test.

145. Preparation for Tests

a. The howitzer will be prepared for action and the candidate will be posted in the position corresponding to the test being conducted or as indicated by the subparagraph entitled "Special Instructions" for each test.

b. The examiner will insure that the candidate understands the requirements of the test.

c. The candidate will report I AM READY before each test.

146. Qualification Scores

Minimum scores required for qualification in the courses are as follows:

Individual classification	Points
Expert gunner	90
First-class gunner	80
Second-class gunner	70

147. Outline of Tests

a. Scope of Tests.

Paragraph	Subject	Number of tests	Points each	Maximum credit
147	Direct laying with panoramic telescope	4	2	8
149	Direct laying with elbow telescope	4	2	8
150	Indirect laying for deflection only	18	2	36
151	Laying for quadrant with the elevation counter	3	2	6
152	Laying for quadrant with the gunner's quadrant	3	2	6
153	Displacement correction	2	—	4
	Part I	(1)	3	(3)
	Part II	(1)	1	(1)
154	Measuring site to the mask	1	4	4
155	Measuring quadrant	1	4	4
156	Measuring deflection	1	4	4
157	Tests and adjustments of sighting and fire control equipment	5	—	10

Paragraph	Subject	Number of tests	Points each	Maximum credit
	Tests 1 and 2.....	(2)	1	(2)
	Test 4.....	(1)	2	(2)
	Tests 3 and 5.....	(2)	3	(6)
158	Material.....	3	—	10
	Test 1.....	(1)	3	(3)
	Test 2.....	(1)	3	(3)
	Test 3.....	(1)	4	(4)
	Total credit.....			100

148. Direct Laying With Panoramic Telescope

a. Scope of Tests.

(1) Four tests (two groups of two tests each) will be conducted.

(2) Tests 1 and 2 (and tests 3 and 4) will be executed as one series of commands.

Test number	Examiner commands	Action of candidate
1 and 3	TARGET THAT TANK, SHELL HE, CHARGE 7, FUZE QUICK, LEAD RIGHT 10, RANGE 800.	Sets lead on the azimuth counter. Traverses the tube until the vertical crosshair is on the center of the target mass. Centers the pitch and cross-level bubbles. Commands FIRE and steps clear.
2 and 4	RIGHT (LEFT) 10, ADD (DROP) 200.....	Sets off change in lead by using click sights. Traverses the tube until the vertical crosshair is on the center of the target. Commands FIRE and steps clear.

d. *Penalties.* No credit will be allowed if, after each test—

(1) The incorrect lead is set on the azimuth counter.

(2) The vertical crosshair is not centered on the mass of the target.

(3) The pitch- and cross-level bubbles are not centered.

e. Credit.

Time in seconds, exactly or less than	5	6	7
Credit	2.0	1.5	1.0

149. Direct Laying With Elbow Telescope

a. Scope of Tests.

b. Special Instruction.

(1) A stationary target will be selected or placed approximately 600 meters from the howitzer.

(2) The azimuth counter will be set to 3,200 mils, and the gunner's aid counter will be set to zero.

(3) The howitzer will be pointed so that a 100-mil shift will be required for tests 1 and 2.

(4) The candidate will be posted as the gunner.

(5) The laying of the piece will not be disturbed after tests 1 and 3.

(6) The examiner will reverse the assumed direction of movement of the target for test 3.

c. Outline of Tests.

(1) Four tests (two groups of two tests each) will be conducted.

(2) Tests 1 and 2 (and tests 3 and 4) will be executed as one series of commands.

(3) The candidate will be tested as the assistant gunner in the two-man, two-sight system.

b. Special Instructions.

(1) A stationary target will be placed approximately 600 meters from the howitzer.

(2) For tests 1 and 3, the range gageline as viewed through the telescope will be placed more than 100 meters away from the target.

(3) The laying of the piece will not be disturbed after tests 1 and 3.

c. Outline of Tests.

Test number	Examiner commands	Action of candidate
1 and 3	TARGET THAT TANK, SHELL HE, CHARGE 7, FUZE QUICK, LEAD LEFT 5, RANGE 600.	Places the range gageline on the range commanded. Elevates the tube until the range gageline is centered on the visible mass of the target. Calls SET and steps clear.
2 and 4	ADD (DROP) 200.....	Same as that for tests 1 and 3 above.

d. Penalties. No credit will be given if, after each test, the correct range gageline is not on the center of the visible mass of the target.

e. Credit.

Time in seconds, exactly
or less than ----- 2 2½ 3
Credit ----- 2.0 1.5 1.0

150. Indirect Laying for Deflection Only

a. Scope of Tests.

(1) Eighteen tests (two groups of nine tests each) will be conducted.

(2) Tests 1 through 9 (and tests 10 through 18) will be executed as one series of commands.

b. Special Instructions.

(1) The examiner will identify an aiming point for the candidate.

(2) Special corrections will be given *only* in the tests indicated in *c* below.

(3) The deflection limits for each test are as follows:

Test number	Maximum change (mils)	Minimum change (mils)
2 and 11.....	180	140
3 and 12.....	90	70
7 and 16.....	100	60
8 and 17.....	50	30
9 and 18.....	20	10

(4) The howitzer will be laid with the correct deflection at the conclusion of each test before the next test is begun.

(5) The reference collimator or the aiming posts will be set out at the deflection specified by unit SOP.

(6) The examiner will designate the section number of the piece to be used and will specify any special corrections in deflection to be applied by the candidate.

(7) The candidate will be posted as gunner.

c. Outline of Tests.

Test number	Examiner commands	Action of candidate
1 and 10	SPECIAL CORRECTIONS, DEFLECTION 3200, NUMBER 1 LEFT 7.	Sets deflection and applies special correction. Centers cross-level and pitch-level bubbles. Traverses the piece until the numbers on the panoramic telescope coincide with the corresponding numbers on the reference collimator. Checks centering of bubbles. Re-lays the piece if necessary. Calls READY and steps clear.
2 and 11	DEFLECTION 3050.....	Sets deflection. Leaves correction on gunner's aid counter. Lays on reference collimator. Checks centering of bubbles. Re-lays the piece if necessary. Calls READY and steps clear.
3 and 12	DEFLECTION 3130.....	Same as test 2 above.
4 and 13	NUMBER 1 RIGHT 4.....	Same as test 2 except that the candidate sets <i>right</i> 4 on the gunner's aid counter.
	At the conclusion of test 4 (and 13), announce END OF MISSION. (Operation is not timed.)	Sets gunner's aid counter to zero.
5 and 14	AIMING POINT, CHURCH STEEPLE (or such-and-such), REFER.	Refers telescope to church steeple. Uncovers azimuth counter. Reads deflection and calls NUMBER (so-and-so), DEFLECTION (so much).
6 and 15	DEFLECTION 3200, REFER.....	Rotates reset knob until reset counter reads 3200. Verifies that the vertical crosshair is on the church steeple. Calls NUMBER (so-and-so), DEFLECTION 3200. Steps clear.
7 and 16	SPECIAL CORRECTIONS, DEFLECTION 3129, NUMBER 1 LEFT 6.	Same as test 1 above.
8 and 17	DEFLECTION 3069.....	Same as test 2 above.
9 and 18	DEFLECTION 3071.....	Same as test 2 above.

d. Penalties. No credit will be given if, after each test—

(1) The deflection is not set correctly.

(2) The cross-level and pitch-level bubbles are not centered.

(3) The numbers on the reticle of the pano-

ramic telescope do not coincide exactly with the corresponding numbers on the reference collimator or if the vertical crosshair of the panoramic telescope is not on the left edges of the aiming posts.

(4) Last motion in traverse is not from left to right.

e. Credit.

Time in seconds, exactly or less than			
Tests 1, 10, 6 and 15	12	13	15
Other tests	8	9	10
Credit	2.0	1.5	1.0

Test number	Examiner commands	Action of candidate
1	QUADRANT 375	Sets quadrant on the elevation counter. Centers pitch- and cross-level bubbles. Calls SET and steps clear.
2	QUADRANT 342	Same as test 1 above.
3	SPECIAL CORRECTIONS, NUMBER 1 UP 2, QUADRANT 363.	Same as test 1 above except that the candidate sets up 2 on the correction aid counter.

d. Penalties. No credit will be allowed if, after each test—

- (1) The quadrant is not set accurately.
- (2) The cross-level and pitch-level bubbles are not centered.
- (3) The last movement of the tube was not in the direction in which the tube is more difficult to elevate.

e. Credit.

Time in seconds, exactly or less than	4	5 2/5	6 4/5
Credit	2.0	1.5	1.0

Test number	Examiner commands	Action of candidate
1	QUADRANT 210	Sets quadrant elevation on the gunner's quadrant. Seats the quadrant. Directs his assistant to elevate or depress the tube until the quadrant bubble is centered. Calls READY and awaits verification of the laying.
2	QUADRANT 257	Same as test 1 above.
3	QUADRANT 203	Same as test 1 above.

d. Penalties. No credit will be allowed if, after each test—

- (1) The quadrant elevation is not set correctly.
- (2) The quadrant is not properly seated.
- (3) The quadrant bubble is not properly centered.

151. Laying for Quadrant With the Elevation Counter

- a. Scope of Tests.* Three tests will be conducted.
- b. Special Instructions.*

(1) Each test will require a change from 20 to 40 mils.

(2) Commands in tests 2 and 3 *will not* be in multiples of five.

(3) The candidate will be posted as assistant gunner.

(4) The setting on the elevation counter will be within 40 mils of the initial elevation.

c. Outline of Tests.

152. Laying for Quadrant With the Gunner's Quadrant

- a. Scope of Tests.* Three tests will be conducted.
- b. Special Instructions.*

(1) The gunner's quadrant will be set at 0 for the first test.

(2) Tests 2 and 3 will require changes from 30 to 60 mils.

(3) The candidate will be posted to the left of and facing the breech and will be holding the gunners' quadrant.

(4) An assistant will elevate or depress the tube as directed by the candidate.

c. Outline of Tests.

(4) The last movement of the tube was not in the direction in which the tube is more difficult to elevate.

e. Credit.

Time in seconds, exactly or less than	6	6 3/5	7
Credit	2.0	1.5	1.0

153. Displacement Correction

a. *Scope of Test.* One test consisting of two parts will be conducted.

b. *Special Instructions.*

(1) Aiming posts or the collimator will be set out at prescribed distances.

(2) An assistant will be stationed by the far aiming post or the collimator.

(3) The examiner will require the candidate to lay the piece on an announced deflection and report I AM READY.

(4) The piece will be moved to cause a 5- to 10-mil aiming post displacement.

(5) The lay of the howitzer at the end of the first part of the test will not be disturbed for the second part.

c. *Outline of Test.*

(1) *Part I.*

Examiner commands	Action of candidate
CORRECT FOR DISPLACEMENT.	Lays howitzer so that the far aiming post appears midway between the near aiming post and the verticle crosshair of the telescope or obtains correct sight picture of collimator, if used. Checks centering of bubbles. Re-lays the piece if necessary. Calls READY and steps clear.

(2) *Part II.*

Examiner commands	Action of candidate
ALINE AIMING POSTS.	Sets 3200 on the reset counter dial. Directs assistant in alining aiming posts or collimator. Calls READY and steps clear.

d. *Penalties.*

(1) *Part I.* No credit will be allowed if—

(a) The far aiming post does not appear midway between the near aiming post and the vertical hairline of the telescope or if an incorrect sight picture was used with the collimator.

(b) The cross-level and pitch-level bubbles are not centered.

(c) The final motion of traverse was not from left to right.

(2) *Part II.* No credit will be allowed if—

(a) The deflection is other than the announced deflection.

(b) Aiming posts are not properly alined.

(c) The vertical crosshair of the telescope

is not on the left edges of the aiming posts or on the zero line of the collimator.

e. *Credit.*

Part I, time in seconds, exactly or less than -----	3 1/3	3 2/3	4
Credit -----	3.0	2.0	1.0
Part II (no time limit) Credit -----	1.0	---	---

154. Measuring Site To the Crest

a. *Scope of Test.* One test will be conducted.

b. *Special Instructions.*

(1) The howitzer will be prepared for action and placed 200 to 400 meters from a mask of reasonable height.

(2) The tube will be pointed 100 to 150 mils above the crest and 100 to 150 mils to the right or left of the highest point on the crest.

(3) The candidate will be posted at the rear of the breech.

(4) An assistant will traverse and elevate the tube as directed by the candidate.

c. *Outline of Test.*

Examiner commands	Action of candidate
MEASURE SITE TO CREST.	Sights along lowest element of the bore and directs the movement of the tube until the line of sight just clears the highest point of the crest. Centers the cross-level and pitch-level bubbles. Reads the elevation from the elevation counter. Reports NUMBER (so-and-so), SITE TO CREST (so much).

d. *Penalties.* No credit will be allowed if—

(1) The line of sight along the lowest element of the bore does not just clear the crest.

(2) The cross-level and pitch-level bubbles are not properly centered.

(3) Site is not announced correctly.

(4) The last movement of the tube was not in the direction in which the tube is more difficult to elevate.

e. *Credit.*

Time in seconds, exactly or less than -----	14	15	16	17
Credit -----	4.0	3.0	2.0	1.5

155. Measuring Quadrant

a. *Scope of Test.* One test is conducted.

b. *Special Instructions.* Before the test the ex-

aminer will lay the tube at a selected quadrant and will set the gunners' quadrant to 0.

c. Outline of Test.

Examiner commands	Action of candidate
MEASURE THE QUADRANT.	Places gunner's quadrant on the breech quadrant seats. Levels the bubble on the gunner's quadrant by raising the index arm and turning the micrometer knob. Announces NUMBER (so-and-so), QUADRANT (so much).

d. Penalties. No credit will be allowed if—

- (1) The quadrant bubble is not centered when the quadrant is properly seated.
- (2) The quadrant is not announced correctly.

e. Credit.

Time in seconds, exactly or less than -----	8	9 2/5	10 3/5
Credit -----	4.0	3.0	2.0

156. Measuring Deflection

a. Scope of Test. One test will be conducted.

b. Special Instructions.

- (1) The piece will be laid on the reference collimator or the aiming posts.
- (2) An aiming point within 200 mils left or right of the reference collimator or the aiming posts will be designated and will be identified by the candidate.

c. Outline of Test.

Examiner commands	Action of candidate
NUMBER 1, AIM- ING POINT THAT MARKER, REFER.	Centers the cross-level and pitch-level bubbles. Refers to aiming point. Reads deflection from the azimuth counter and reports NUMBER 1, DEFLECTION (so much), and steps clear.

d. Penalties. No credit will be allowed if—

- (1) The cross-level and pitch-level bubbles are not centered properly.

(2) Vertical crosshair of the telescope is not on the aiming point.

(3) Deflection is not announced correctly.

(4) The weapon is traversed.

e. Credit.

Time in seconds, exactly or less than ----	5	5 3/5	6	6 3/5
Credit -----	4.0	3.0	2.0	1.5

157. Tests and Adjustments of Sighting and Fire Control Equipment

a. Scope of Tests. Five tests will be conducted in which the candidate will be required to—

(1) Demonstrate the testing methods and authorized adjustment of sighting and fire control equipment.

(2) Describe the action to be taken (e.g., equipment sent to ordnance) if adjustment is not authorized by the user.

b. Special Instructions.

(1) The piece will be prepared for tests as indicated in chapter 6 of this manual.

(2) Necessary items of equipment are bore-sights, testing target, gunner's quadrant, and plumbline.

(3) An assistant will elevate or depress the tube as directed by the candidate during tests 1 and 2 and will aline the testing target for test 5.

(4) Tests will be conducted in numerical order.

(5) The gunner's quadrant used for tests 1 and 2 will be used for tests 3 and 4 with the correction determined in test 1, provided the correction does not exceed 0.4 mil.

(6) Adjustments of the telescope mount and linkage will be made in accordance with TM 9-1015-234-12.

(7) Tube will be leveled after test 2 and will not be disturbed thereafter.

c. Outline of Tests.

Test number	Examiner commands	Action of candidate
1	PERFORM END-FOR-END TEST OF THE GUNNER'S QUADRANT.	Perform test as prescribed in paragraph 106. Announces ERROR (so many) MILS, QUADRANT SERVICEABLE (UNSERVICEABLE) and hands the quadrant to the examiner.
2	PERFORM MICROMETER TESTS OF THE GUNNER'S QUADRANT. <i>Note:</i> Level the tube at conclusion of test 2.	Performs test as prescribed in paragraph 107. Announces QUADRANT MICROMETER IS (IS NOT) IN ERROR.

Test number	Examiner commands	Action of candidate
3	TEST PANORAMIC TELESCOPE MOUNT AND TELESCOPE.	Performs tests as prescribed in paragraphs 110 through 113. Calls READY when tests have been completed.
4	PERFORMS CHECK OF THE ELEVATION QUADRANT.	Performs check as prescribed in paragraph 114. Calls READY when check has been completed.
5	BORESIGHT THE HOWITZER.....	Performs tests and makes adjustments as prescribed in chapter 9. Calls READY and steps clear.

d. Penalties. The tests are not essentially speed tests. The times specified in (1) through (5) below are prescribed to insure that the candidate performs the tests without wasted effort.

(1) *Test 1.* No credit will be allowed if—

(a) The bubble in the gunner's quadrant does not center when checked by the examiner.

(b) The candidate does not correctly announce the error (one-half of the angle that was indicated when the quadrant was first reversed and the bubble was centered by using the index arm and the micrometer knob).

(c) The candidate fails to declare the quadrant unserviceable when the error exceeds 0.4 mil or fails to declare the quadrant serviceable when the error is 0.4 mil or less.

(d) The candidate requires more than 2 minutes to complete the test.

(2) *Test 2.* No credit will be allowed if—

(a) The candidate does not follow the correct procedure.

(b) The candidate requires more than 1 minute to complete the test.

(3) *Test 3.* No credit will be allowed if—

(a) The candidate does not follow the correct procedure.

(b) The candidate does not declare the telescope mount unserviceable when bubbles are out of level in excess of one-half vial graduation.

(c) The candidate does not declare the telescope mount unserviceable when the readings disagree by more than 0.5 mil.

Note. No time limit is prescribed for this test.

(4) *Test 4.* No credit will be allowed if—

(a) The candidate does not follow the correct procedure.

(b) The candidate fails to notify the exam-

iner when the reading on the gunner's quadrant disagrees with the elevation quadrant.

Note. No time limit is prescribed for this test.

(5) *Test 5.* No credit will be allowed if—

(a) The candidate fails to make indicated adjustments.

(b) The candidate does not adjust azimuth counter to read exactly 3200.

(c) The direct fire telescope is not alined properly.

(d) The candidate requires more than 4½ minutes to complete tests and adjustments.

e. Credit. If tests and adjustments are completed within prescribed limits, maximum credit will be given as follows:

Test	Points
1	1
2	1
3	3
4	2
5	3

Maximum Credit 10

158. Materiel

a. Scope of Tests. Three tests will be conducted.

b. Special Instructions.

(1) *Tests 1 and 2.* A paulin will be placed on the ground for layout of disassembled parts. The candidate will be allowed to select the tools prior to the test. The candidate may have an assistant to aid him in moving the breechblock.

(2) *Test 3.* A complete set of lubrication equipment and lubricants authorized for use by battery personnel will be made available. Lubricants will be clearly marked.

c. Outline of Tests.

Test number	Examiner commands	Action of candidate
1	DISASSEMBLE BREECH MECHANISM.....	Performs operation as prescribed in TM 9-1015-234-12. Identifies all parts to the examiner.
2	ASSEMBLE BREECH MECHANISM AND FIRING LOCK.	Performs operation as prescribed in TM 9-1015-234-12.
3	PERFORM DAILY AND QUARTERLY LUBRICATION.	Selects proper lubricants and equipment. Shows how, when, and with which lubricant each point is serviced. (Candidate does not perform actual lubrication. Checks all lubricant levels.

d. Penalties.

(1) The tests are not speed tests; however, times are prescribed to insure that the candidate performs the tests without wasted effort.

(2) No credit will be given if the following time limits are exceeded:

<i>Test</i>	<i>Time (minutes)</i>
1	8
2	12
3	5

(3) One-half point will be assessed for each component incorrectly identified in test 1. There are no prescribed time limits for identifying the

components; however, the examiner may reduce the grade if the candidate is obviously unfamiliar with the components.

(4) One-half point will be assessed for each lubrication point missed, each inappropriate lubricant selected, and each inappropriate lubricating device selected.

e. Credit.

<i>Test</i>	<i>Points</i>
1	3
2	3
3	4

Maximum credit 10

APPENDIX

REFERENCES

1. Army Regulations

- AR 310-25, Dictionary of United States Army Terms.
- AR 310-50, Authorized Abbreviations and Brevity Codes.
- AR 385-63, Regulations for Firing Ammunition for Training, Target Practice, and Combat.
- AR 611-201, Enlisted Military Occupational Specialties.
- AR 672-5-1, Awards.
- AR 750-5, Organization Policies and Responsibilities for Maintenance Operations.

2. DA Pamphlets

- DA Pam 108-1, Index of Army Motion Pictures, and Related Audio-Visual Aids.
- DA Pam 310-series, Index of Military Publications.

3. Field Manuals

- FM 5-15, Field Fortifications.
- FM 5-20, Camouflage.
- FM 5-25, Explosives and Demolitions.
- FM 6-20-2, Field Artillery Techniques.
- FM 6-40, Field Artillery Cannon Gunnery.
- FM 6-125, Qualification Tests for Specialists, Field Artillery.
- FM 6-140, Field Artillery Cannon Battalions and Batteries.
- FM 21-5, Military Training Management.
- FM 21-30, Military Symbols.
- FM 21-40, Chemical, Biological, Radiological and Nuclear Defense.
- FM 21-60, Visual Signals.

- FM 22-5, Drill and Ceremonies.
- FM 31-70, Basic Cold Weather Manual.

4. Technical Manuals

- TM 3-220, Chemical, Biological, and Radiological (CBR) Decontamination.
- TM 9-238, Deepwater Fording of Ordnance Materiel.
- TM 9-575, Auxiliary Sighting and Fire Control Equipment.
- TM 9-1527, Ordnance Maintenance: Gunner's Quadrants M1 and M1918 and Machine Gun Clinometer M1917.
- TM 9-1590, Ordnance Maintenance: Fuze Setters, M14, M22, M23, M25, and M27.
- TM 9-1300-203, Artillery Ammunition.
- TM 9-500, Data Sheets for Ordnance Type Materiel.
- TM 9-1015-234-12, Operator and Organizational Maintenance Manual for Howitzer, Light, Towed, 105-mm, M102.
- TM 38-750, The Army Maintenance Management System (TAMMS).

5. Miscellaneous

- ATP 6-100, Field Artillery Cannon Units.
- ATT 6-157, Field Artillery Battery, Light (Medium) Howitzer Towed (Self-Propelled).
- FT 105-H-6, Firing Tables for Howitzer, 105-mm.
- SC 1305/30-IL, Ammunition, 75-mm Through 125-mm.
- SC 1340/98-IL, Ammunition and Explosives, Class 1390—Fuzes and Primers.

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BY ORDER OF THE SECRETARY OF THE ARMY:

W. C. WESTMORELAND,
General, United States Army,
Chief of Staff.

OFFICIAL

KENNETH G. WICKHAM,
Major General, United States Army,
The Adjutant General.

Distribution:

To be distributed in accordance with DA Form 12-11 requirements for 105MM Howitzer, LT, M
102 TOWED.



Table 5. Trajectory Characteristics

Projectile range (meters)	Elevation (mils) with HE, Chg 7	Trajectory characteristics	Firing data	Projectile range (meters)	Elevation (mils) with HE P-T
100	2	Within these ranges, the trajectory is flat enough to prevent an 8-foot tank from passing under it. A range of 400 meters is ideal for opening fire.	Start firing with a 400-meter range setting	100	1
200	4			200	3
300	6			300	4
400	8			400	6
500	11			500	8
				600	9
				700	11
600	13	Within these ranges, bracket adjustment of the target is required. 200-meter range changes should be made until a bracket is obtained.	1. Start firing with the estimated range to the nearest 100 meters.	800	13
700	15			900	15
800	18		2. Adjustment on the target by bracketing (overs and shorts) is required.	1,000	17
900	20			1,100	19
1,000	22			1,200	21
1,100	25		3. Make 200-meter range changes until a bracket is obtained.	1,300	23
1,200	27			1,400	26
1,300	30				
1,400	33				
1,500	35	At ranges over 1,400 meters, bracket adjustment of the target is required. 400-meter range changes should be made until a bracket is obtained.	1. Start firing with the estimated range to the nearest 100 meters.	1,500	28
1,600	38			1,600	31
1,700	41		2. Adjustment on the target by bracketing (overs and shorts) is required.	1,700	34
1,800	43			1,800	37
			3. Make 400-meter range changes until a bracket is obtained.		

Table 5



Table 8. Schedule

Method*	Hours	Subject	Text reference	Training aids and equipment
C, D, PW	1-----	Organization and composition of howitzer section; general duties of individuals; formation of howitzer section.	Paragraphs 5, 6, and 9. Tables 1, 2, 3, and 4.	Gun and prime mover.
C, D, PW	1-----	Posts and posting of cannoneers; changing posts, mounting and dismounting.	Paragraphs 9-14-----	Gun and prime mover.
C, D, PW	2 (1-hour periods)---	Coupling and uncoupling, preparing for action and march order, movement of howitzer by hand.	Tables 1 and 2-----	Gun and prime mover.
C, D, PW	24 (½-hour periods)---	Howitzer drill—duties in firing, indirect laying.	Chapter 5. Table 3----	TOE equipment.
C, D, PW	9 (½-hour periods)---	Howitzer drill—duties in firing, direct laying.	Chapter 6. Table 4----	TOE equipment.
C, D, PW	6 (1-hour and ½-hour periods).	Testing and adjusting of sighting and fire control equipment.	Chapter 10-----	TOE equipment.
C, D, PW	2 (½-hour periods)---	Collimator and aiming post-----	Paragraphs 81 and 82--	TOE equipment, black-board, and chalk.
C, D, PW	4 (1-hour periods)---	Inspections and maintenance-----	Chapter 11-----	TOE equipment.
C, D	1-----	Decontamination of materiel-----	Chapter 12-----	Decontamination equipment; TOE equipment.
C, D, PW	1-----	Destruction of materiel to prevent use by the enemy.	Chapter 13-----	Decontamination equipment; TOE equipment.
C, D	1-----	Safety precautions-----	Chapter 14-----	TOE equipment.
PW	16 (4-hour periods)---	Service practice, indirect laying-----	Chapter 5. Table 3----	TOE equipment.
PW	4-----	Service practice, direct laying-----	Chapter 6. Table 4----	TOE equipment.
C, PW	6-----	Review and tests of subjects previously covered.	All previous references--	TOE equipment.
Total 78 hours				

*C—Conference; D—Demonstration; PW—Practical Work

Table 8

Table 1. Duties in Prepare for Action

Sequence	Chief of section	Gunner	Assistant gunner	Number 1	Number 2	Number 3	Number 4	Number 5
1	Commands PREPARE FOR ACTION. Supervises work of cannoneers during all activities.	Commands UNCOUPLE. Disconnects the howitzer light system from the prime mover. Unlatches the pintle.	Removes the howitzer tail light assembly and muzzle cover and places them in the section chest.	Grasp the right and left lifting handles respectively and lift the lunette from the pintle lowering the trail until the terra tire is on the ground.				
2	If the piece is to be moved by hand, commands: 1. PIECE FORWARD (BACKWARD) 2. MARCH. When the piece is in the firing position, commands HALT, and the piece is stopped.	Directs the piece with the lunette.	If the piece is to be moved up or down steep slopes, alternately set and release the hand brakes permitting the howitzer to pivot, moving in a zig-zag manner.		Grasps right side of trail at a convenient location. Moves piece in the approximate direction.	Grasps left side of trail at a convenient location. Moves piece in the approximate direction.	Grasps right lifting handle. Moves piece in the approximate direction.	Grasps left lifting handle. Moves piece in the appropriate direction.
3	Insures that the area required for 6,400 mil traverse is clear of obstacles.				Removes lunette lock pin, turns lunette 180° to the firing position, and replaces locking pin.	Disconnects and secures gun travel lock.	Remove right wheel suspension quick release pin. Replace pin in stowage position.	Remove left wheel suspension quick release pin. Replace pin in stowage position.
4	Insures that all personnel are clear of the tube and firing platform. Commands number 1 to pull the actuator quick release lanyard when directed by the executive officer.			Caution: Do not use the quick release method of operating the actuator unless directed by the chief of section. Warning: Personnel must stand clear of the weapon while operating the actuator. Do not remove the pin from the actuator control unless the quick release method is to be used. Assists number 2 in cranking wheels up past center point.	Secures crank and cranks wheels past center point. Removes crank and places it with other equipment. Assist numbers 4 and 5 by shifting the trail as directed when securing the firing platform.		Insures right hand brake is released. Assists number 5 to secure the firing platform in position. Caution: At least 2 stakes must be emplaced prior to firing the howitzer for charges up to and including charge 6. Additional stakes should be emplaced as soon as possible. The total number of stakes to be emplaced depends on the soil and is determined by the chief of section. In firing charge 7, all 8 stakes should be emplaced prior to firing the howitzer.	Insures left hand brake is released. Assisted by number 4, drive sufficient stakes as directed by the chief of section, to secure the firing platform during firing. Caution: Extreme care must be exercised in order not to strike the howitzer with the hammer while driving the stakes.
5	In order to direct action other than to the front the chief of section may command ACTION REAR. If the command is ACTION RIGHT (LEFT) the howitzer is turned 90° in the approximate direction.						Grasp right and left lifting handles respectively and turn the howitzer 180° in a clockwise direction.	
6	Checks recoil system for proper amount of oil, verifies that no leaks exist and direct servicing as required. Proper oil reserve is indicated by a protrusion less than 1/16", depending on the temperature. Below 40° F., the indicator will protrude more than at warmer temperatures prior to firing. (See TM 9-1015-234-12.)	Remove protective cover from panoramic telescope. Presses elbow release lever and moves telescope eyepiece to a convenient viewing position. Raises 90° prism cover to open position. Uncovers level vials. Uncovers azimuth 5,400 mil counter, sets counter to 3,200 and zeros the gunner's aid. Levels the telescope mount. Checks functioning of traversing mechanism.	Removes cover from elbow telescope and elevation quadrant. Operates elbow telescope latches. Turns telescope to the firing position, and slides the telescope forward into the key ways and secures latches. Uncovers elevation quadrant level vials. Sets elevation counter to 300, sets correction counter to zero. Levels the elevation quadrant. Checks functioning of elevating mechanism.	Prepares and emplaces the collimator to the left rear at a deflection between 400-800 mils at a distance from 4 to 12 meters from the weapon. Orients the collimator on the panoramic telescope and crosslevels the reticle. Lays the electrical cable from the collimator to the gunner's position on command from the chief of section. Sets out aiming posts when used as a substitute for the collimator.	Assisted by numbers 3 and 4, unloads and arranges ammunition and section equipment.	Assisted by number 4, spreads paulin to left rear of howitzer. Assists number 2 to unload ammunition and equipment.	Assists number 3 to spread paulin. Assists number 2 to unload ammunition and equipment.	Lays communication cable from the howitzer to the MX155-GT or terminal strip. Prepares the telephone for use and assures operation of communication equipment.
7			Assisted by number 1, cleans and dries the breech mechanism, chamber and bore.	Assembles the rammer staff and rammer head. Assists the assistant gunner to clear and dry the breech mechanism, chamber, and bore.				
8	Verifies the adjustments of the sighting and fire control equipment.	Test and align fire control equipment (boresight).		Holds and emplaces the testing target as required.				Assists number 1 in holding the testing target.
9	*Measures site to the crest, assisted by the gunner and assistant gunner.	*Assists chief of section in measuring site to crest. *Lays howitzer for direction.	*Assists chief of section in measuring site to crest.				Sets the far aiming post to the right front at a deflection between 3600-3400 mils approximately 100 meters from the piece.	
10	*Indicates alternate aiming point to the gunner when one is designated by the executive.	*Directs alignment of the infinity aiming reference collimator without disturbing the lay of the tube. *Directs alignment of aiming posts.	Checks direct fire telescope: 1. Adjusts eyepiece diopter for convenient viewing. 2. Verifies functioning of telescope range gauge line.				Places the near aiming post midway between the piece and the far aiming post and sets it as directed by the gunner.	
11	Verifies that the howitzer is prepared for action. Reports to executive "Number () in order" or reports any defects that the section cannot remedy without delay.							

* These steps may be omitted during training when drill does not include laying off of the piece.



Table 2. Duties in Preparing for Traveling

Sequence	Chief of section	Gunner	Assistant gunner	Number 1	Number 2	Number 3	Number 4	Number 5
1	Commands MARCH ORDER. Inspects the chamber to verify that the piece is not loaded. Supervises work of cannoneers during all activities.	Sets azimuth counter to 3,200 mils and closes window. Sets correction counter to zero. Closes 90° prism. Presses elbow release lever and places eyepiece in the traveling position. Covers level vials. Places pitch and cross-level mechanism in the approximate center of movement. Replaces protective cover on telescope and mount.	Sets elevation counter and correction counters to zero. Releases elbow telescope latches, slides telescope slightly to the rear, turns telescope to the traveling position and secures the latches. Places quadrant in approximate center of movement. Covers level vials. Replaces protective cover on telescope and quadrant. Inspects the chamber and bore to see that they are clear. Closes the breech block after the chamber and bore has been checked by the chief of section.	Assists number 2 to raise the firing platform to the travel position. Recovers, disassembles, and stows the reference collimator.	Replaces fuze setters and tools in the section chest, or howitzer stowage compartment as required. Assisted by number 1, raises the firing platform to the travel position.	Recovers, disassembles, and stows aiming posts.	Drives stakes until the top of the stakes are flush with the platform. Assists number 5 to remove stakes.	Assisted by number 4, removes the stakes from the ground and stows them in the section chest.
2				Replaces right wheel suspension quick release pin.	Replaces left wheel suspension quick release pin.	Connects and secures gun travel lock.		
3	Directs prime mover into the howitzer position. Commands COUPLE.	Latches the pintle. Connects howitzer light system to prime mover.	Places tail light and muzzle cover assembly on the howitzer.	Disassembles and secures the rammer staff.	Removes lunette pin, rotates lunette 180° to the travel position, and replaces locking pin.	Repack fuzes and ammunition as directed by the chief of section.		Repacks fuzes and ammunition as directed by the chief of section. Retrieves and secures communications equipment.
				Grasp left and right lifting handles respectively, raise the trail, and place lunette in the prime mover pintle.		Under direct supervision of the chief of section, replaces powder increments in cartridge cases. Insure that all increments are present, in proper order, of proper log number and in good condition.		
4	Assisted by the gunner verifies that the section is prepared for travel. Commands MOUNT.	Assists the chief of section in supervising the March Order. Mounts in prime mover.	Takes post..... Mounts in prime mover.....	Takes post..... Mounts in prime mover.....	Takes post..... Mounts in prime mover.....	Takes post..... Mounts in prime mover.....	Takes post..... Mounts in prime mover.....	Takes post. Mounts in prime mover.
5	Reports to executive "Number () in order," or reports any defect the section cannot remedy without delay.							

Table 2

Table 3. Duties in Firing, Indirect Laying

Sequence	Chief of section	Gunner	Assistant gunner	Number 1	Number 2	Number 3	Number 4	Number 5
1	Supervises the work of the section throughout all sequences and insures an efficient and safe operation.							
2	Follows fire commands and repeats commands to the section as required. Lays for quadrant with the gunner's quadrant when commanded.	Sets the announced deflection on the azimuth reset counter and centers the pitch and cross-level bubbles.	Sets the announced quadrant on the elevation counter and elevates or depresses the tube until the elevation vial bubble is centered. Centers cross-level bubble.	Receives the prepared round from No. 3 and loads the howitzer on the command QUADRANT.	Fuzes or changes fuze on the projectile. Sets fuzes assisted by No. 3.	Prepares propellant charge and gives unused increments to No. 4. Assists in preparing projectile after the propellant has been cut. 1. Fits projectile into cartridge case assisted by No. 5. 2. Holds projectile upright for fuzing and fuze setting. 3. Reads and announces fuze setting when requested. Passes prepared round to No. 1.	Remove ammunition from containers and inspect and clean projectiles. Takes unused powder increments to the powder pit.	Remove ammunition from containers and inspect and clean projectiles. Assists No. 3 in his duties.
3			Closes the breech.					
4	Insures the weapon is ready to fire and indicates to the executive that it is ready to fire by raising his arm and/or announcing NUMBER (so-and-so) READY.	Traverses the piece to the announced deflection, insures that bubbles are centered after the breech has been closed and announces READY after the assistant gunner announces SET.	Insures settings are correct and that bubbles are level and announces SET.					
5	On the command of the executive, commands FIRE and/or lowers his arm.		Fires the howitzer.					
6	Observes and checks the functioning of material during firing. Reports errors, unusual incidents, and equipment malfunctions to the executive.		Opens the breech.	Recovers expended cartridge cases and throws them to the right rear of the howitzer. Inspects the bore and chamber to insure they are free of residue and announces BORE CLEAR if appropriate. Calls out number and quadrant for each round in continuous fire.	Removes fuze from unfired projectile.			

Table 3

Table 4. DUTIES IN FIRING, DIRECT LAYING

Sequence	Chief of Section	Gunner	Assistant Gunner	Number 1 through 5
1	Conducts the fire of his howitzer and alerts section to prepare for direct fire.	Prepares the panoramic telescope.	Prepares elbow telescope.	Perform the same duties as in indirect laying.
2	Identifies or selects the target. Takes a post to the flank and slightly to the rear of the piece where his observation will not be obscured. Estimates the range to the target. Determines lead.			
3	Gives initial commands, an example of which might be TARGET, TANK, SHELL HE, CHARGE 7, FUZE QUICK, LEAD 10, RANGE 600.	Set the proper lead on the azimuth counter and take up correct sight picture.	Lay the piece for range and calls "Set."	
4		Commands FIRE, after the assistant gunner calls, "Set."		No. 1 fires the piece when the gunner commands FIRE.
5	Gives subsequent commands based on observed effect an example of which might be: RIGHT 5, ADD 100.	Sets new lead on panoramic telescope and continues as above.	Sets new range on elbow telescope and continues as above.	
6	Commands END OF MISSION when target is destroyed or neutralized.			

Table 4



Table 6. Before operation Service

Sequence	Chief of section	Gunner	Assistant gunner	Number 1	Number 2	Number 3	Number 4	Number 5	Driver
1	Supervises inspections by members of the gun section in all sequences.	Inspects condition, completeness, contents, and security of section chest.						Assists the prime mover driver in inspection and maintenance of his vehicle when directed to do so by the chief of section. Loads ammunition in prime mover as directed.	Performs "before operation" duties as prescribed in appropriate technical manual for his prime mover, assisted by cannoneer number 5 when so directed by chief of section.
2	Verifies that howitzer is properly coupled.	Releases left wheel handbrake.	Releases right wheel handbrake before coupling.	Inspects condition of rammer staff.					
3	Verifies that handbrakes are released.			Disconnects and removes light system from howitzer.	Inspects canvas covers for torn or worn places and for broken or missing fastenings.				
4	Inspects recoil system for signs of oil leakage.	Removes breech end cover.				Removes muzzle plug.			
5	Supervises the gunner in making tests and adjustments of sighting and fire control equipment.	Inspects condition and security of sighting and fire control equipment, except elbow telescope.	Inspects elbow telescope for condition and security. Inspects breechblock, firing mechanism, chamber, and bore for cleanliness, freedom from foreign matter, and lubrication.	Inspects tires for wear, bruises, cuts, stones in treads, and for proper air pressure. Inspects wheels for loose or missing nuts, hubcap screws, and valve caps.	Inspects drawbar to see that it is in proper position and securely locked.	Inspects left wheel suspension quick release pin to see it is in traveling position.	Inspects right wheel suspension quick release pin to see it is in traveling position.		
6	Inspects oil index to insure that proper reserve of oil is present in the recoil system (TM 9-1015-234-12).		Check breech and elevating mechanism for smooth operation.			Inspects cradle travel lock for fastening.	Inspects condition and security of collimator.		
7	Inspects ammunition for lot number, condition, and stowage.			Determines presence of ample supply of cleaning and preserving material.	Inspects carriage for loose parts, condition of tube fittings, and for cracked or broken welds.				
8	Verifies presence of proper supply of gasoline, oil, water, and emergency rations.			Inspect quick release lanyard and safety pin on actuator assembly.					
9	Inspects loading of section equipment for completeness and security.				Inspects for grease and oil leakage on or under carriage.		Cleans recoil slides.		
10	Verifies presence of technical manuals and lubrication orders for prime mover and howitzer, equipment log book, accident report form, and vehicle identification card.	Replace breech end cover.				Replaces muzzle plug.			
11				Replaces and connects light system on howitzer.	Loads ammunition and equipment in prime mover.	Loads ammunition and equipment in prime mover.			
12	Receives reports of personnel of his section upon completion of their duties in inspection.	Reports, "Gunner ready."	Reports, "Assistant gunner ready."	Reports, "Number 1 ready."	Reports, "Number 2 ready."	Reports, "Number 3 ready."	Reports, "Number 4 ready."	Reports, "Number 5 ready."	Reports, "Driver ready."
13	Reports to battery executive when section personnel have completed their duties, "Sir, Number () in order," or reports any defects which the section cannot remedy without delay or assistance.								



Table 7. After operation Service

Sequence	Chief of section	Gunner	Assistant gunner	Number 1	Number 2	Number 3	Number 4	Number 5	Driver
1	Supervises detailed inspection and maintenance of howitzer in all sequences.	Inspects for presence of all sighting and fire control equipment, cleans, secures, and, to the extent that he is authorized, lubricates them.	Inspects, cleans, and secures elbow telescope.	Removes, cleans, and replaces rammer staff.				As directed by the chief of section. May assist prime mover driver in inspection and maintenance or perform other duties as directed by chief of section.	Performs after operation duties as prescribed for his vehicle, assisted by cannoneer number 5 when so directed by chief of section.
2	Inspects tools, accessories, and equipment for completeness and condition.			Inspects tires and wheels for damage and loose or missing parts; tests air pressure of tires and corrects if it is necessary.					
3	Inspects ammunition for lot number, complete rounds, and general condition.			Removes and cleans light system equipment and stores it in section chest.	Inspects fastenings and general condition of covers.				
4		Remove breech cover.		Cleans and lubricates the bore.		Remove muzzle cover.			
5	Inspects recoil system for signs of leakage and supervises filling to correct oil reserve when necessary (TM 9-1015-234-12).		Removes, cleans, oils, and replaces breech mechanism, assisted by section personnel as directed by chief of section.	Cleans howitzer and carriage.		Clean howitzer and carriage.			
6	Verifies the presence of and makes current entries in the equipment log books, and other required documents.	Inspects bore and breech mechanism after cleaning.			Lubricates howitzer and carriage.	Lubricates howitzer and carriage.	Removes, cleans, lubricates, and returns aiming posts, and cleans collimator.		
7	Verifies that there is an ample supply of emergency rations, oil, water, and gasoline.	Checks the contents of the section chest, and inspects for condition of chest and contents.			Inspects carriage for loose or missing nuts, bolts, rivets, and broken welds; looks for excess grease or oil under carriage.				
8		Replace breech cover.			Cleans, lubricates, and returns fuze setters to section chest.	Replace muzzle cover.			
9							Properly stores unused cleaning and preserving materials.		
10	Receives reports from members of the section as they complete inspection and maintenance operations.	Reports, "Gunner ready."	Reports, "Assistant gunner ready."	Reports, "Number 1 ready."	Reports, "Number 2 ready."	Reports, "Number 3 ready."	Reports, "Number 4 ready."	Reports, "Number 5 ready."	Reports, "Driver ready."
11	Reports to battery executive "Number () in order."								

Table 7



FM 6-70 105-MM HOWITZER, LIGHT, M102, TOWED-1970

